Series 1958, No. 30

Issued June 1964

SOIL SURVEY

MINNEHAHA COUNTY SOUTH DAKOTA

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Minnehaha County, S. Dak., will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid farmers in selecting suitable trees and shrubs; and add to our knowledge of soil science.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of Soils" and then turn to the section "Use and Management of Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the capability unit and windbreak suitability group, and the page where each of these is described.

Engineers will want to refer to the subsection "Engineering Uses of Soils." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Formation and Classification of Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Minnehaha County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

* * * * *

Fieldwork for this survey was completed in 1958. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. The soil survey of Minnehaha County was made as part of the technical assistance furnished by the Soil Conservation Service to the Minnehaha County Soil and Water Conservation District.

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Issued June 1964

SOIL SURVEY OF MINNEHAHA COUNTY, SOUTH DAKOTA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

MINNEHAHA COUNTY is in the southeastern part of South Dakota (fig. 1). Its total area is 521,600 acres, or about 815 square miles. Sioux Falls is the county seat and is the largest city in the State.

Agriculture is the chief source of income in the county. Corn, oats, barley, soybeans, flax, and alfalfa are the main crops. Other crops include bromegrass, sweetclover, and sorghums. These crops are vital to the extensive livestock raising operation. The chief problems of management on cultivated soils are erosion, wetness, and the maintenance of fertility.

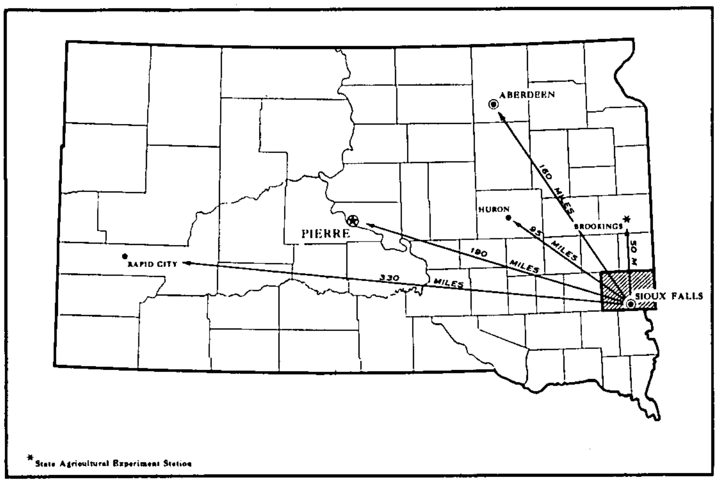

Figure 1.—Location of Minnehaha County in South Dakota.

The Minnehaha County Soil and Water Conservation District at Sioux Falls arranges for farmers to receive technical help through the Soil Conservation Service in planning good use and conservation of their soils. This soil survey furnishes some of the facts needed for this technical help. The soil survey map and report are also useful to land appraisers, credit agencies, road engineers, and others who are concerned with the use and management of soils.

The fieldwork for this survey was completed in 1958. Unless noted otherwise, all statements refer to conditions at the time of the survey.

[1] Others who contributed to the soil survey are J. T. DUNLAVY, R. L. HOWEY, DUANE C. MOXON, T. J. OLLILA, MILES SMALLEY, and E. LUMB, Soil Conservation Service, United States Department of Agriculture.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Minnehaha County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Kranzburg and Moody, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Flandreau loam is a soil type in the Flandreau series.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or in some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Flandreau loam, 1 to 3 percent slopes, is one of several phases of Flandreau

loam, a soil type that ranges from nearly level to strongly sloping in Minnehaha County.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because these show woodlands, buildings, field borders, trees, and similar details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area consisting dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, he shows this mixture of soils as one mapping unit or soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Buse-Kranzburg soils. Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rock land or Alluvial land, and are called land types rather than soils.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units, and had shown the location of the mapping units on the soil map. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, managers of rangeland, and engineers.

To do this efficiently, the soil scientist had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; windbreak suitability groups, for those who need to establish field and farmstead windbreaks; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After study of the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. Such a map is the colored general soil map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic although not strictly uniform.

The soils within any one association are likely to differ from one another in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general soil map shows, not the kind of soil at any particular place, but patterns of soils, in each of which there are several different kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soils of one soil association may also be present in another association, but in a different pattern.

The general map showing patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

The general soil map of Minnehaha County shows 10 soil associations, which are described in the following pages.

1. Luton-Dimmick association: Fine textured to moderately fine textured soils on flood plains

This association occurs on level or nearly level bottoms along the Big Sioux River and its tributaries. It contains soils that are moderately well drained to very poorly drained, and it amounts to about 8 percent of the county. The Luton and the Dimmick soils are the main soils in this association, but the Lamoure, La Prairie, and Rauville soils also occur.

The Luton soils are fine textured and moderately fine textured in the surface layer and subsoil. They are somewhat poorly drained and are flooded occasionally. Because they are wet late in the spring, tillage is delayed. Luton soils make up about 70 percent of the association. Most areas are cropped.

The Dimmick soils are more poorly drained and are finer textured than the Luton soils. They occupy broad, swampy, slightly depressed areas on bottoms and make up about 15 percent of the association. Dimmick soils are not cultivated unless they are drained or diked.

The Lamoure soils are coarser textured than the Luton soils and are limy at or near the surface. These soils are somewhat poorly drained to poorly drained, have a seasonally high water table, and are susceptible to flooding. Lamoure soils are used for pasture and crops. The La Prairie soils occupy the higher benches on the bottoms. They are moderately well drained and medium textured. Flooding is infrequent. The Rauville soils are fine textured and very poorly drained. Water stands on them for long periods because they are generally in old stream channels that are blocked. They are not suitable for cultivation. Most areas of Rauville soils in the county occur in areas of Luton soils and Dimmick soils.

The soils in this association that can be cultivated are fertile but are difficult to till. They dry out slowly in the spring, and planting is usually delayed. Flooding is also a problem, especially during the spring thaws and after heavy rains. Corn, soybeans, small grains, and alfalfa are grown and produce good to high yields if precipitation is normal or less than normal. Some of the wetter areas can be used for hay or pasture.

2. Fordville-Estelline association: Medium-textured soils over sand and gravel on stream terraces

This association consists of nearly level to gently sloping soils on stream terraces along the Big Sioux River

and along Skunk Creek. It makes up about 4 percent of the county. The Fordville and Estelline soils are the main soils in this association, but the Athelwold and the Sioux soils also occur. The Fordville and the Estelline soils are well drained. The Fordville soils are 10 to 36 inches deep to sand and gravel, and in most places, the Estelline soils are more than 36 inches deep to sand and gravel. The Athelwold soils are moderately well drained and are deep to sand and gravel. The Sioux soils are shallow to gravel.

The soils in this association are generally cultivated and produce fair to good yields. Corn, small grains, and alfalfa are grown. The water-holding capacity is fair. Because of the underlying sand and gravel, these soils are somewhat droughty. Wind erosion is a problem in areas where the surface is not protected. Sheet erosion is likely where runoff on the gentle slopes is uncontrolled.

3. Benclare association: Fine-textured soils in loess on stream terraces

This association consists of moderately well drained to poorly drained soils high on nearly level to gently sloping stream terraces. The soils formed in sediments deposited by wind or water. The main area of this association is west of Valley Springs on a terrace along Beaver Creek. This association makes up about 2 percent of the county.

This association consists of the moderately well drained and the poorly drained Benclare soils. The moderately well drained Benclare soil is deep, is nearly level to gently sloping, and makes up about 80 percent of the association. The poorly drained Benclare soil occupies the swales and depressions and is wet because water runs in from the higher soils.

Most of this association is cultivated. Corn, soybeans, small grains, and alfalfa produce good to high yields on the better drained soils. Crops fail at times on the wetter sites. Except in sloping areas, erosion is not a problem.

4. Moody-Trent association: Moderately fine textured soils in loess on uplands

This association consists of nearly level to gently sloping soils that formed in loess on uplands. The main area of this association is in the northeastern part of the county, but other areas are scattered in the eastern two-thirds. This association makes up about 7 percent of the county.

The Moody and the Trent soils (fig. 2) are dominant, but also present are Hidewood and Alcester soils and small areas of other soils. The Moody soils lie on nearly level to gently sloping uplands and are deep and well drained. They make up about 70 percent of this association. The Trent soils are in lower positions than the Moody soils and are deep and moderately well drained. They make up about 20 percent of the association. The Hidewood soils are in swales and depressions and at the head of drains; they are deep and somewhat poorly drained. The Alcester soils are in narrow valleys and on foot slopes, where they formed in sediments that washed down from the adjacent uplands. They are deep and moderately well drained.

Nearly all of this association is cultivated. Corn, small grains, soybeans, and alfalfa produce high yields. This association is one of the better farming areas in the county, and the use of the soils generally is not restricted by erosion or wetness.

5. Nora-Moody association: Medium-textured and moderately fine textured soils in loess on uplands

This association consists of well-drained soils on slopes ranging from 3 to 9 percent. These soils formed in loess on uplands in the eastern two-thirds of the county and make up about 37 percent of the county.

The Nora and the Moody soils are the main soils in this association, but the Alcester, Crofton, and Flandreau soils, and Alluvial land also occur. The Nora soils occupy about 60 percent of this association, and the Moody soils about 30 percent. The rest of the association consists of the Alcester, Crofton, and Flandreau soils and of Alluvial land.

Moody and Nora soils are deep and silty. The Moody soils are on gentle slopes and have a thick surface layer and subsoil. The depth to lime is 30 inches or more. Nora soils are on steeper slopes than the Moody soils and have a thinner surface layer. The depth to lime in Nora soils ranges from 10 to 36 inches. The Alcester soils are in narrow valleys and on foot slopes. These soils formed in sediments washed from adjacent uplands and are deep and moderately well drained. Crofton soils formed in loess on the knolls, breaks, and eroded, steep side slopes. They are deep but have a thin surface soil. Lime is at or near the surface. Flandreau soils are deep, well-drained, medium-textured soils that formed in loess over sand. The depth to sand is about 36 inches. These soils are nearly level to moderately sloping. Alluvial land consists of soil material that washed into the drainageways from higher land.

About 85 percent of this association is cultivated. Corn, small grains, soybeans, and alfalfa are grown and generally produce good to fair yields. Because these soils are silty and have rapid runoff, they erode easily. Runoff from these soils deposits more sediment than runoff from other soils of the county.

6. Egeland-Maddock association: Medium-textured and coarse-textured soils in windblown sands on uplands and terraces

This association consists of nearly level to moderately steep, sandy soils on uplands. Most areas of this association are east of the Big Sioux River and east of Skunk Creek on ridgetops that run northwest and southeast. This association makes up about 4 percent of the county.

The Egeland and the Maddock soils are the main soils, but the Hecla and the Hamar soils also occur. The Egeland soils are the most productive in the association. They are deep, well-drained soils on high stream terraces and on uplands. They have a medium-textured surface layer and a coarse-textured subsoil. Maddock soils are generally on steeper slopes than the Egeland soils, and are deep, excessively drained, and sandy. The Hecla soils are deep and moderately well drained. Most areas are near U.S. Highway No. 77 between Sioux Falls and Renner, in positions between the breaks of the Big Sioux River and the bottoms. The Hamar soils are in depressions surrounded by the Hecla soils and are somewhat poorly drained.

About 70 percent of this association is cultivated. The corn, small grains, and alfalfa produce poor to fair yields. The main soils in this association are generally susceptible to wind and water erosion and are droughty. Part of this association near Sioux Falls has been subdivided for residences.

7. Vienna association: Medium-textured soils in glacial till on uplands

This association consists of well-drained soils that formed in glacial till on uplands. All areas of this association are east of the Big Sioux River, and they make up about 2 percent of the county.

The Vienna soils are the main soils, but small areas of Buse soils occur on the steep eroded slopes. The Vienna soils occur on slopes of 1 to 9 percent. They are deep, well drained, and medium textured and are more productive than the Buse soils. The Buse soils are on hillsides, breaks, and knolls. They are thin, excessively drained, and medium textured.

About 70 percent of this association is cultivated. Corn, small grains, and alfalfa are grown and produce fair to good yields. The soils in this association are eroded in some places and are susceptible to erosion in most places. The soils on steeper slopes have rapid runoff.

8. Buse-Sioux association: Coarse-textured and medium-textured soils in glacial drift

This association consists of thin, excessively drained soils that formed in glacial drift on hilly uplands, gravelly knobs and ridges, and stream terraces. Although a large area of this association is east of Sioux Falls, other areas occur in nearly all parts of the county. This association occupies about 4 percent of the county.

The Buse and the Sioux soils are the main soils, but small areas of the Vienna, Crofton, and Fordville soils

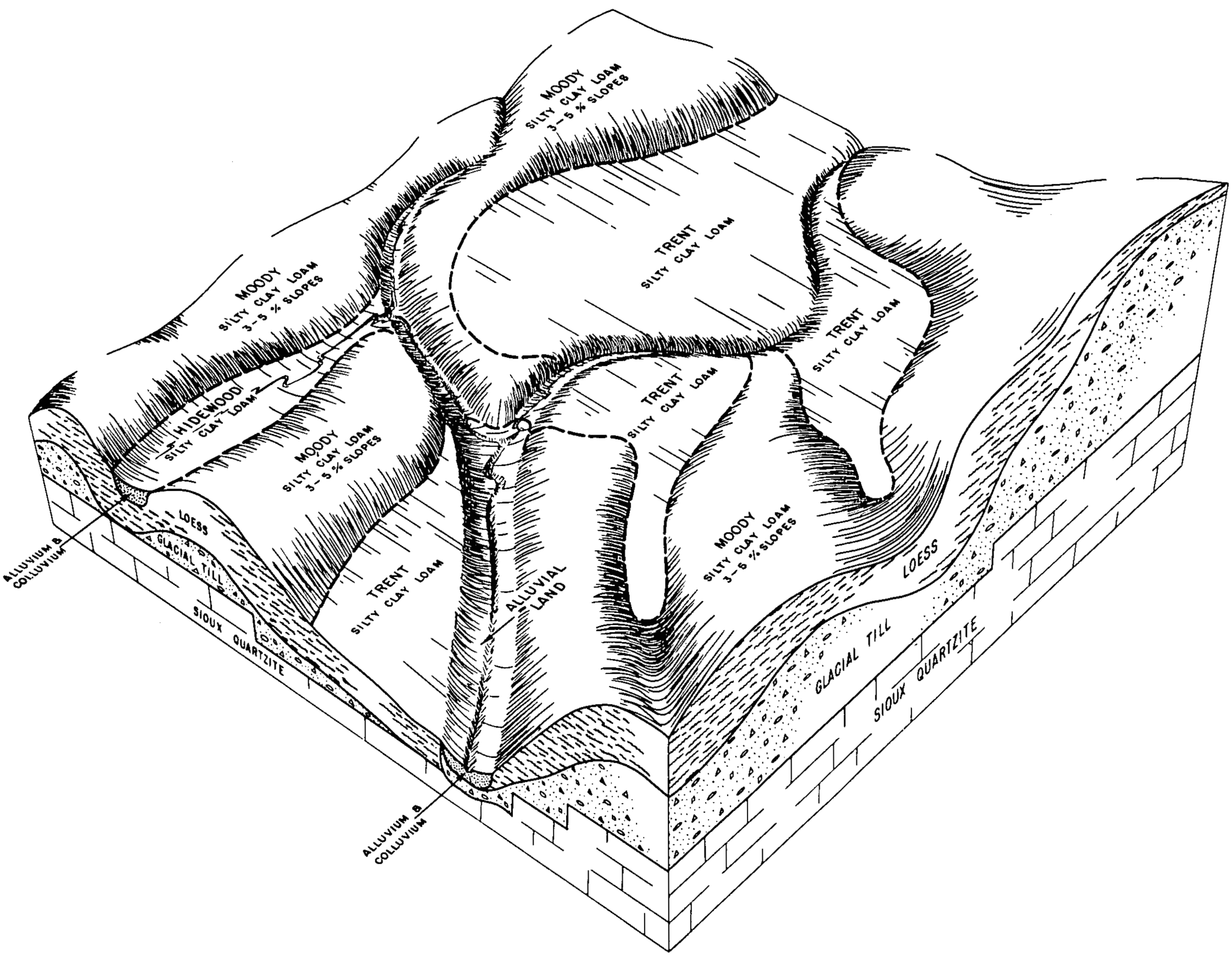

Figure 2.—**Block diagram showing the geographical association of the soils in association 4. Here, the soils formed in a mantle of loess which lies over glacial till.**

also occur. Buse soils formed in glacial till and are thin, excessively drained, and medium textured. They occur on sloping hillsides, breaks, and knolls. Sioux soils are coarser textured than Buse soils and are shallow to gravel. They occur in uplands on gravelly knobs or ridges, or on steep slopes along drainageways.

This association is mostly in pasture. The soils are droughty, and runoff is excessive. Some areas are too stony or steep for safe operation of farm machinery. Commercial gravel is obtained from the Cactus Hills and other gravelly areas.

9. Kranzburg-Parnell association: Moderately fine textured and fine textured soils in loess and till

This association consists of the nearly level to rolling soils on uplands and in depressions in the western part of the county. It makes up about 31 percent of the county.

The Kranzburg, Parnell, and Brookings soils (fig. 3) are the main soils, but the Buse, Hidewood, and Beadle soils also occur. The Kranzburg soils formed in silty material on uplands and are deep, well drained, and moderately fine textured. The Parnell soils are in depressions or potholes in sediments washed from adjacent uplands. They are deep, poorly drained, and moderately fine textured to fine textured. The Brookings soils are in slight swales and at the head of drains, and are deep, moderately well drained, and medium textured. Hidewood soils are similar to Parnell soils but are better drained. Beadle soils are deep, well drained, and medium textured.

About 80 percent of this association is cultivated. Corn, small grains, soybeans, and alfalfa produce good to high yields. Wet or steep areas are generally used for hay or pasture, but some areas are drained and cultivated. If excessive runoff is not controlled, soils on slopes will erode.

10. Rock land association: Rock outcrops and shallow soils

This association consists of soils that are shallow to quartzite bedrock and occur on uplands and on bottoms. The soils on uplands occur in cracks or as a thin mantle

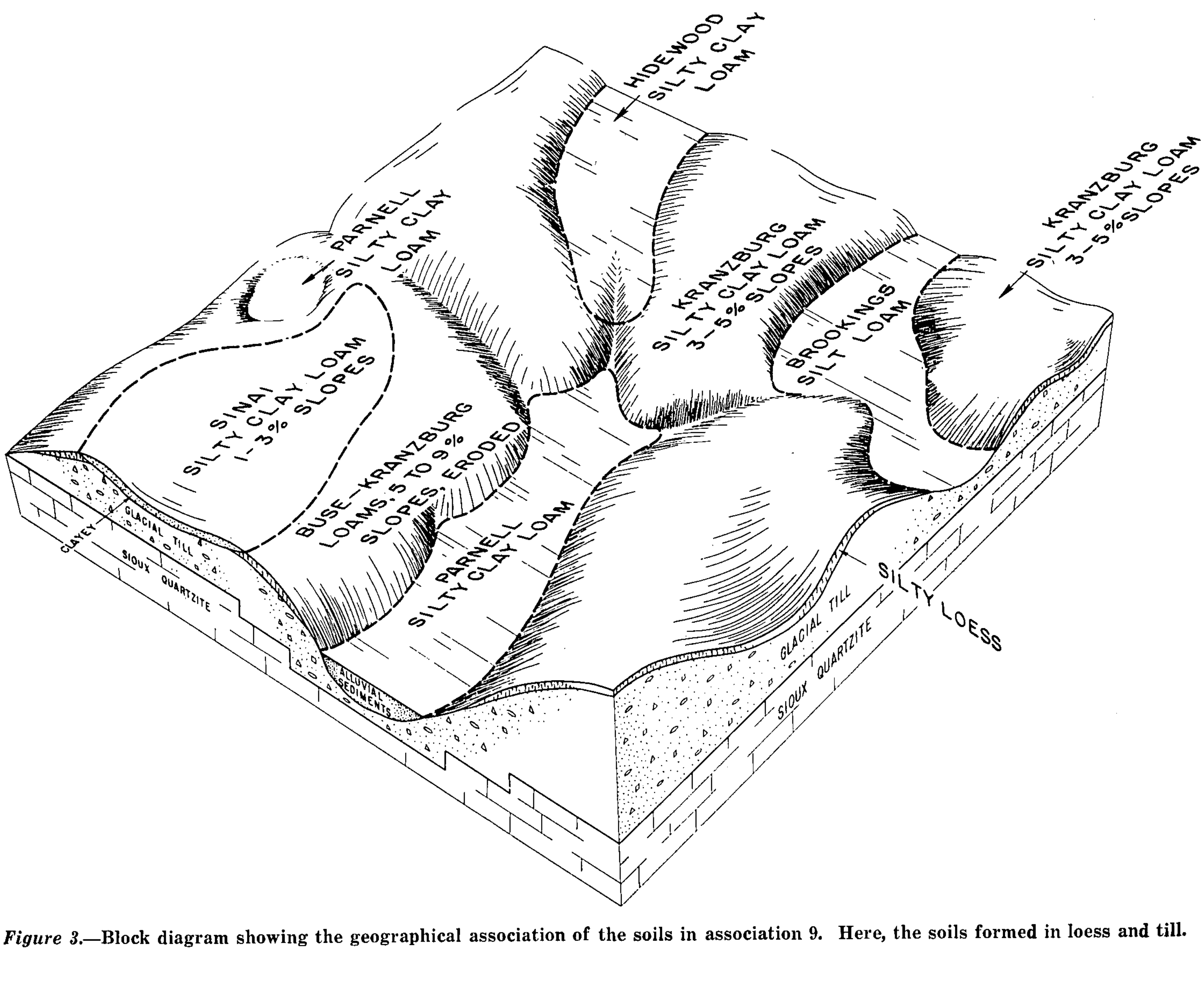

Figure 3.—**Block diagram showing the geographical association of the soils in association 9. Here, the soils formed in loess and till.**

over rock. The soils on bottoms are in sediments that have been deposited in a thin layer over rock. Boulders, stones, and gravel are scattered over this association, and many cliffs have formed. The association makes up about 1 percent of the county.

Within this association are the Dells and the Palisades, as well as quarries near Dell Rapids and Sioux Falls. The Dells and the Palisades are used for recreation. Some parts of this association are in pasture, but most areas are too rocky or too steep for agricultural use.

Descriptions of Soils

This section describes in nontechnical language the soil series (groups of soils) and single soils (mapping units) of Minnehaha County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. First described is a profile that was observed in the county and is considered typical of the series. Then the variations from the typical profile are discussed. The series described is then compared to a similar series in the county. The closing statements tell about the general use and suitability of the soils in the series. Thus, to get full information of any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How Soils are Named, Mapped, and Classified," not all mapping units are members of a soil series. Rock land, Terrace escarpments, and other miscellaneous land types do not belong to a soil series but, nevertheless, are listed in alphabetic order along with the soil series.

TABLE 1.—*Approximate area and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Alcester silt loam, 1 to 3 percent slopes	6, 318	1. 2
Alcester silt loam, 3 to 5 percent slopes	976	. 2
Alluvial land	41, 053	7. 9
Alluvial land, rocky	60	[1]
Athelwold silt loam	350	. 1
Benclare silty clay loam	2, 681	. 5
Benclare silty clay loam, poorly drained	663	. 1
Brookings silt loam	3, 790	. 7
Buse-Kranzburg loams, 5 to 9 percent slopes, eroded	25, 583	4. 9
Buse-Kranzburg loams, 9 to 17 percent slopes, eroded	4, 433	. 8
Buse-Kranzburg stony loams	2, 621	. 5
Buse loam, 9 to 17 percent slopes	1, 544	. 3
Buse soils, steep	5, 774	1. 1
Buse stony loam, 5 to 17 percent slopes	10	[1]
Buse-Sioux complex	4, 336	. 8
Buse-Vienna loams, 5 to 9 percent slopes, eroded	131	[1]
Corson silty clay, 1 to 3 percent slopes	49	[1]
Corson silty clay, 3 to 5 percent slopes, eroded	375	. 1
Corson silty clay, 5 to 9 percent slopes, eroded	234	[1]
Crofton silt loam, 5 to 9 percent slopes, eroded	108	[1]
Crofton silt loam, 9 to 17 percent slopes, eroded	977	. 2
Crofton silt loam, 17 to 30 percent slopes	283	. 1
Dimmick clay	1, 377	. 3
Egeland loam, 1 to 3 percent slopes	2, 062	. 4
Egeland loam, 3 to 5 percent slopes	2, 275	. 4
Egeland loam, 5 to 9 percent slopes, eroded	2, 441	. 5
Estelline silt loam, 0 to 2 percent slopes	16, 411	3. 1
Estelline silt loam, 3 to 4 percent slopes	285	. 1
Flandreau loam, 1 to 3 percent slopes	3, 534	. 7
Flandreau loam, 3 to 5 percent slopes	4, 653	. 9
Flandreau loam, 3 to 5 percent slopes, eroded	830	. 2
Flandreau loam, 5 to 9 percent slopes, eroded	2, 366	. 5
Fordville loam, 1 to 3 percent slopes	4, 067	. 8
Fordville loam, 3 to 5 percent slopes	1, 410	. 3
Hecla-Hamar complex	1, 779	. 3
Hidewood silty clay loam	7, 003	1. 3
Hidewood silty clay loam, calcareous	568	. 1
Kranzburg-Beadle silty clay loams, 1 to 3 percent slopes	542	. 1
Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes	1, 360	. 3
Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes	172	[1]
Kranzburg-Buse loams, 3 to 5 percent slopes	2, 893	. 6
Kranzburg silty clay loam, 1 to 3 percent slopes	24, 575	4. 7
Kranzburg silty clay loam, 3 to 5 percent slopes	67, 632	13. 0
Kranzburg silty clay loam, 5 to 9 percent slopes, eroded	8, 220	1. 6
Lamoure silty clay loam	4, 225	. 8
La Prairie complex	5, 742	1. 1
La Prairie silt loam	10, 140	1. 9
Luton clay	12, 224	2. 3
Maddock loamy fine sand, 3 to 5 percent slopes, eroded	1, 916	. 4
Maddock loamy fine sand, 5 to 9 percent slopes, eroded	1, 493	. 3
Maddock loamy fine sand, 9 to 17 percent slopes, eroded	774	. 1
Moody-Nora silty clay loams, 3 to 5 percent slopes	15, 905	3. 0
Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded	14, 677	2. 8
Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded	66, 795	12. 8
Moody silty clay loam, 1 to 3 percent slopes	25, 393	4. 9
Moody silty clay loam, 3 to 5 percent slopes	40, 052	7. 7
Moody silty clay loam, moderately shallow, 0 to 2 percent slopes	120	[1]
Nora-Crofton silt loams, 5 to 9 percent slopes, eroded	12, 119	2. 3
Nora-Crofton silt loams, 9 to 17 percent slopes, eroded	10, 718	2. 1
Parnell silty clay loam	4, 237	. 8
Rauville silty clay loam	1, 142	. 2
Rock land	1, 420	. 3
Sinai silty clay, 1 to 3 percent slopes	2, 684	. 5
Sinai silty clay, 3 to 5 percent slopes	506	. 1
Terrace escarpments	1, 636	. 3
Trent silty clay loam	14, 081	2. 7
Trent-slickspot complex	471	. 1
Vienna silt loam, 1 to 3 percent slopes	254	[1]
Vienna silt loam, 3 to 5 percent slopes	2, 262	. 4
Vienna silt loam, 5 to 9 percent slopes	305	. 1
Vienna silt loam, 5 to 9 percent slopes, eroded	1, 515	. 3
Marsh	6, 035	1. 2
Gravel pits	396	. 1
Water	3, 559	. 7
Total	521, 600	100. 0

[1] Less than 0.1 percent.

A soil symbol in parentheses follows each mapping unit and identifies that unit on the detailed soil map. Listed at the end of the description of a mapping unit are the capability unit and windbreak suitability group in which that kind of soil has been placed. The pages on which each capability unit is described can be found readily by referring to the "Guide to Mapping Units, Capability Units, and Windbreak Suitability Groups" at the back of the report.

Soil scientists, teachers, engineers, and others who want detailed information about soil series should turn to the section "Formation and Classification of Soils." Many terms used in the soil descriptions and in other sections of the report are defined in the Glossary.

Alcester Series

In the Alcester series are deep, moderately well drained, medium-textured soils that formed in material washed from loess-covered uplands. These soils occur in narrow valleys and on foot slopes along large streams.

The surface layer is very dark gray or black silt loam, about 12 inches thick. It generally is friable and granular but is blocky in some places. It is easy to work.

The subsoil is about 26 inches thick. The upper part is dark gray to very dark gray silt loam and has medium, prismatic structure. This upper part grades to the lower part, which is light yellowish-brown, or yellowish-brown silty clay loam. The prisms are coarser in the lower part than in the upper part.

The parent material is silty clay loam in most places, and it contains soft, white deposits of lime.

The surface layer ranges from 10 to 16 inches in thickness and from silt loam to silty clay loam in texture. The subsoil ranges from 20 to 30 inches in thickness and generally contains more clay than the surface layer. Below a depth of 42 inches the material ranges from silty loess to clay loam glacial till. Stratified sand, silt, and gravel commonly occur along the toe slopes of the larger drains, and sometimes occur in other places.

Alcester soils are moderately well drained and have good permeability. They have a good supply of organic matter. Because of their position, they receive water from the uplands in addition to that received in precipitation. This run-in causes silting. Gullies form in areas where Alcester soils are not protected and the erosive action of water is not checked.

The Alcester soils developed in silty material that washed from the uplands. They have a thicker surface layer than the Moody soils, which developed in loess, and they are not so well drained. The Alcester soils are coarser textured than the Trent soils.

Alcester soils occur in narrow bands along foot slopes and adjacent to stream channels. Because of their location, many areas are in pasture. The larger areas are cultivated and produce good to excellent yields of corn, oats, and alfalfa. The additional water that runs in from higher soils usually benefits crops. Intense rains, however, may cover some areas with water, silt, and debris, particularly the areas close to the rolling, loessal hills. These areas can be protected by diversion terraces constructed on adjoining higher soils.

Alcester silt loam, 1 to 3 percent slopes (AcA).—This soil is in nearly level, narrow strips on the foot slopes and in the narrow valleys of the loessal uplands. It is scattered through the county but is mostly in the eastern two-thirds. Additional water is received in runoff from adjacent uplands.

Use of this soil depends on the location and size of the areas. Areas adjacent to stream channels or steep hills are in pasture. Larger areas are cultivated and produce good to excellent yields.

The surface layer is silt loam, about 14 inches thick. It is underlain by a silty clay loam subsoil, about 28 inches thick. In some places lime occurs below or in the lower part of the subsoil.

This soil can be protected and its tilth improved by seeding grasses and legumes, using needed mineral fertilizers, applying barnyard manure, and returning all crop residue to the surface.

In the valleys of the larger streams, small areas of La Prairie silt loam are included in the mapped areas of this soil. In the upland drainageways, small areas of Hidewood silty clay loam and Hidewood silty clay loam, calcareous, are included.

Capability unit I–2; windbreak suitability group 2.

Alcester silt loam, 3 to 5 percent slopes (AcB).—This soil is similar to Alcester silt loam, 1 to 3 percent slopes, and is in similar locations. Its silt loam surface layer is about 8 to 12 inches thick. The silty clay loam subsoil is about 26 inches thick. In most places lime occurs in the lower part of the subsoil.

Farming this soil is slightly hazardous unless terracing, contour tillage, or other practices are used to control runoff and erosion. Keeping crop residue on the surface helps to maintain organic matter and to protect the soil from sheet erosion. To maintain or increase yields, apply fertilizer according to needs shown by soil tests and field trials. Under good management this soil is highly productive.

Mapped areas of this soil include small areas of Alcester silt loam, 1 to 3 percent slopes; Hidewood silty clay loam; and Hidewood silty clay loam, calcareous.

Capability unit IIe–2; windbreak suitability group 2.

Alluvial Land

Alluvial land is made up of sediments that were recently deposited by water in narrow valleys, in swales, along drainageways, and on nearly level toe slopes. The soil material is variable in texture and generally is stratified. This land is flooded frequently, and the sediments may differ with each flood. In most places the sediments have not been in place long enough for a soil profile to form, but material at a depth of more than 24 inches may be mottled.

Alluvial land (0 to 5 percent slopes) (An).—This land type occurs in narrow valleys, in drainageways, in swales, and on nearly level to gently sloping toe slopes. The surface layer is black to dark-gray loam to silty clay loam in most places. Where the adjacent uplands are sandy, however, sandy sediments have been washed down. Recent deposits are 12 to 24 inches thick in most places, but may be more than 36 inches in some. The

underlying material is stratified clay, silt, sand, or gravel. Alluvial land is limy in some places.

This land supports a good stand of grass and is best used for hay or pasture.

Small areas of Lamoure, La Prairie, and Alcester soils are included in the mapped areas of this land type.

Capability unit Vw-1; windbreak suitability group 5.

Alluvial land, rocky (0 to 3 percent slopes) (Ar).—This land type is on frequently flooded first bottoms, mainly along Split Rock Creek. It is stony, loamy, and shallow to quartzite. Most of the sediments were recently deposited and may be changed with each flood.

This soil material generally is nearly black loam but ranges from loam to fine sand and gravel. It occurs in pockets that have been scoured in the quartzite bedrock and also on the downstream side of boulders. It is limy in some places.

The quartzite crops out in many places, and stones and boulders of quartzite and conglomerate are scattered on the surface. The water table is high, and the soil is usually moist or wet.

Bluegrass and whiteclover dominate in drier areas where the soil material is deep enough for plants to grow. Pasture is the best use. The total acreage is small.

Capability unit VIIs-81; windbreak suitability group not assigned.

Athelwold Series

In the Athelwold series are deep, moderately well drained, medium-textured soils that formed in calcareous material that overlies fine to coarse sand and gravel. These soils occur in nearly level areas and in slight depressions on uplands and on stream terraces. They also occur at the head of drainageways and at the base of gentle slopes.

The surface layer is very dark gray to black silt loam, about 14 inches thick. It is slightly acid. The subsoil is silt loam to a depth of about 40 inches. It is very dark grayish brown to black in the upper part and grades to light olive brown and olive brown in the lower part.

The subsoil is neutral to calcareous and has weak, prismatic structure and moderately fine, subangular blocky structure. The few brown and red mottles in the subsoil indicate moderately good drainage. Root growth is not restricted.

The sandy substratum is calcareous in most places. Variable colors of gray, yellow, and brown indicate that the substratum remains wet longer than the subsoil. The sand in the substratum was deposited either by wind or by water and, in some places, is stratified.

The surface layer of Athelwold soils ranges from 10 to 16 inches in thickness. A seasonally high water table impedes drainage, which is indicated by mottles in the subsoil. The depth to stratified mixed sand and gravel ranges from 36 to 50 inches. Though the Athelwold and the Trent soils occur in similar positions, the Athelwold soils are coarser textured than Trent soils and have a sandy substratum. They are not so well drained as the Estelline, Flandreau, and Fordville soils and have a thicker surface layer than those soils. Athelwold soils are thicker over sand and gravel than the Fordville soils.

Athelwold soils generally occur in small areas next to larger areas of the Estelline and the Fordville soils and are managed in the same way as those soils. Athelwold soils stay in good tilth under good management, but they puddle if they are worked or pastured when wet. A hard crust forms on the surface when these soils dry, and they are difficult to till. Many roots are in the surface layer, most of them in the upper 4 inches. Yields of corn, oats, and alfalfa are good to high when rainfall is average, but yields are slightly less when rainfall is excessive or low.

Athelwold silt loam (0 to 3 percent slopes) (At).—This nearly level soil is in slight depressions on the uplands and stream terraces. Some water runs in from higher, adjacent soils. The profile is like the one described for the series. The mapping unit includes a few small, somewhat poorly drained to poorly drained areas.

The supply of organic matter is good. To maintain the organic matter, plant grasses and legumes, and keep residue on the surface. The permeability of the subsoil is moderately rapid. Tilth is good if management is good.

Most of this soil is cultivated. Small grains or soybeans produce good to excellent yields, and other crops common in the area can be grown.

Capability unit IIs-25; windbreak suitability group 2.

Beadle Series

Soils of the Beadle series are deep and well drained and have a silty surface layer and a firm, clayey subsoil. These soils formed on uplands in glacial till.

In this county the Beadle soils are mapped only in complexes with the Kranzburg soils and occur only in the western part where the older glacial till is exposed. In some places these exposures are along drainageways and on the lower slopes around potholes The total acreage is small.

The surface layer of the Beadle soils is very dark grayish-brown to black silty clay loam, about 7 inches thick. This layer in the uneroded soils is usually friable and easy to work. In eroded soils where the clayey subsoil is exposed, the plow layer is difficult to work.

The subsoil is brown to dark-gray silty clay loam in the upper part and grades to light olive-brown to grayish-brown silty clay in the lower part. The subsoil is about 35 inches thick and has strong prismatic structure. A zone showing large segregations of lime extends from the lower part of the subsoil into the parent material.

The parent material has variable colors of yellowish brown, pale brown, and pale yellow. In most places the parent material is clay loam, and, when dry, is hard to dig.

The surface layer ranges from silty clay loam to clay loam in areas where Beadle soils are near Kranzburg soils. This is because some of the silt mantle of the Kranzburg soils is mixed with the surface layer of Beadle soils. The depth to lime ranges from 14 to 26 inches.

Like the Vienna soils, the Beadle soils developed in glacial till. The Beadle soils, however, can be distin-

guished from the Vienna soils by their better developed prismatic structure and their white eyes, or large segregations of lime. Beadle soils developed in firm glacial till whereas Kranzburg soils developed partly in silty material.

Most of the acreage of Beadle soils is cultivated. Good yields of corn, oats, small grains, and alfalfa are produced under good management. Other crops common in the area also can be grown. Beadle soils on slopes erode if they are not managed well.

Benclare Series

In the Benclare series are deep, moderately well drained to poorly drained, fine-textured soils that formed in sediments deposited by wind or water. These soils occur in slight depressions and in nearly level to gently sloping areas on stream terraces.

The surface layer is very dark gray or black silty clay loam, about 8 inches thick. It is slightly acid or neutral.

The subsoil contains more clay than the surface layer and is silty clay. It is very dark gray or black in the upper part and grades to light brownish gray or olive in the lower part. The subsoil is mildly alkaline in the upper 2 feet and is usually strongly alkaline below 2 feet. It has weak, coarse prisms that break to fine, subangular blocks. A few gray, yellow, and brown mottles indicate that this soil does not have good internal drainage. Ponding of water in the depressions may restrict root growth and cause poor yields.

The clayey substratum, which possibly is old alluvium, is calcareous in most places. Its variable gray, yellow, and brown colors indicate that it remains wet longer than the subsoil. Water moves very slowly in this layer.

The surface layer ranges from 6 to 14 inches in thickness, and the clayey subsoil is 30 to 50 inches thick. Channels filled with silt are in the substratum. The surface layer and the subsoil may have formed in wind-deposited sediments or in alluvium.

Benclare soils are moderately well drained to poorly drained and have moderately slow permeability. They have a good supply of organic matter and a high water-holding capacity.

The Benclare soils have a thicker surface horizon than the Corson soils and are leached deeper. They are nearly as fine textured as the Luton soils. Surface drainage is generally better on the Benclare soils than on the Luton, but the Benclare soils are not so well drained as the Luton. The Benclare soils are finer textured than the Trent soils, which do not have a dense clay substratum.

Nearly all the acreage of the Benclare soils is cultivated. Corn and soybeans are especially well suited, and other crops commonly grown in the area produce good to high yields. The main hazard to management is working these soils when they are too wet or too dry. The Benclare soils puddle if they are worked when wet, and they are cloddy when they dry. Removing the ponded water will improve the poorly drained areas of Benclare soils.

Benclare silty clay loam (0 to 5 percent slopes) (Bc).—This is a moderately well drained soil on nearly level to gently sloping stream terraces. Only a few small areas are in the county. Runoff is moderate to slow but is adequate for good crop production.

The dark-colored, silty clay loam surface layer is about 10 inches thick. The subsoil ranges from silty clay to silty clay loam and is about 24 inches thick. It is mildly alkaline in the upper part and is moderately alkaline in the lower part. Variable colors in the subsoil indicate that internal drainage is somewhat slow.

The tilth and permeability of this soil can be improved by using legumes for green manure, mixing crop residue into the surface soil, and adding organic and inorganic fertilizers.

Included in mapped areas of this soil are a few small areas of poorly drained Benclare silty clay loam in depressions.

Capability unit IIs–1; windbreak suitability group 3.

Benclare silty clay loam, poorly drained (0 to 2 percent slopes) (Bd).—This soil is on flats and in slight depressions, and it receives water from the uplands in addition to that received in precipitation. It occurs, in a small acreage, with well-drained Benclare silty clay loam.

The surface layer is silty clay loam, about 12 inches thick. The subsoil contains more clay than the surface layer and is about 30 inches thick. Lime usually occurs at a depth of 28 inches. The underlying material is calcareous clay.

This soil is difficult to farm. When flooding occurs and corn cannot be planted, catch crops such as sudangrass, millet, or soybeans are substituted for corn. Drainage and bedding may be required to reduce excess water.

Included in mapped areas of this soil is a small acreage of moderately well drained Benclare silty clay loam.

Capability unit IVw–1; windbreak suitability group 5.

Brookings Series

Soils of the Brookings series are deep, moderately well drained, and medium textured. They formed in silty material underlain by firm glacial till. These soils occur at the head of drains and in other slight depressions and are level and nearly level.

The surface layer is nearly neutral, very dark gray to black silt loam, about 14 inches thick. Many roots are in the upper 4 to 6 inches of this layer.

The subsoil is silty clay loam to a depth of about 45 inches. It is dark grayish brown or black in the upper part and grayish brown or olive brown in the lower part. This layer is generally calcareous at a depth of 29 inches. The coarse prisms in the subsoil break readily to subangular blocks. A few yellowish-colored mottles in the subsoil indicate that these soils are moderately well drained. Root growth is not restricted.

The underlying material is calcareous silty clay loam in most places, but in some places it is sandy or gravelly directly above the glacial till. This material ranges from light gray to grayish brown and is mottled with yellow mottles that have dark-colored centers. This mottling is more prominent than that in the subsoil and indicates that this material remains wet longer than the subsoil.

The surface layer ranges from 8 to 16 inches in thickness and from silt loam to silty clay loam in texture.

Because they are in depressions, these soils receive sediments washed from higher soils, although these sediments generally are not thick enough to damage crops. The thickness of the subsoil ranges from 24 to 40 inches. Yellow mottles in the lower subsoil and in the underlying till vary in size and color. Accumulated lime generally is at a depth below 16 inches, but in a few places it is below 36 inches. The depth to firm glacial till is usually more than 30 inches.

The Brookings soils receive water that runs in from adjacent uplands and deposits sediments in varying amounts. The natural fertility of these soils is high or very high, and the water-holding capacity is high.

The Brookings soils have a thicker surface layer and subsoil than have the Kranzburg soils but not such good drainage. They are better drained than Parnell soils.

Most Brookings soils in this county are in small areas scattered over the western part. These small areas occur closely with larger areas of Kranzburg soils and seldom are managed separately. Yields of corn, oats, and alfalfa are good to excellent when rainfall is average but are slightly less when rainfall is excessive.

Brookings silt loam (0 to 2 percent slopes) (Be).—This level soil is in slight depressions. Because of the water that runs in, drainage is not so good in the deeper depressions as it is in the shallower ones. The permeability in the surface layer and subsoil is moderate, and that of the underlying material is somewhat slower. Tilth and the supply of organic matter are good under good management.

Most areas of this soil are cultivated. Corn, small grains, and alfalfa produce good to excellent yields under good management. Other crops common in the area can be grown. Good tilth can be maintained and the soil protected by seeding grasses and legumes, applying needed mineral fertilizers and barnyard manure, and returning all crop residue to the surface layer.

Capability unit I–2; windbreak suitability group 2.

Buse Series

In the Buse series are excessively drained, medium-textured soils that formed in glacial till on rolling and steep uplands.

The surface layer is dark grayish-brown to very dark grayish-brown loam, about 5 inches thick. It is calcareous in most places, and its organic-matter content is low. This layer usually has fine, granular structure.

The subsoil is light brownish-gray or very dark grayish-brown and dark grayish-brown silty clay loam or clay loam that is calcareous and has subangular blocky structure.

The underlying parent material is usually firm glacial till. This layer is strongly calcareous (fig. 4). It has variable colors of yellow, olive yellow, and yellowish brown.

The surface layer ranges from 2 to 6 inches in thickness and from loam to clay loam in texture. Pebbles and stones on the surface and in the profile vary in size and in amount. The parent material is glacial till that ranges from friable to firm. In the western part of the county the underlying material may be stratified silt and clay that contains seams of sand and gravel or includes a cobbly layer at the contact with the firm glacial till.

These excessively drained soils are low in natural fertility and are stony in some places. If they are cultivated or overgrazed, they are likely to erode.

The Buse soils occur with the well-drained Kranzburg and the Vienna soils. They are distinguished from those soils by their thinner surface layer, by their lack of a well-developed subsoil, and by their lime at or near the surface.

Buse soils normally are not cultivated, but the less sloping areas that occur closely with deeper soils are used for corn, small grains, and alfalfa. Buse soils produce good yields of grass, and their best use is for pasture or hay.

Buse-Kranzburg loams, 5 to 9 percent slopes, eroded (BKC2).—This complex occurs on rolling uplands in the western part of the county. It is made up of Buse and Kranzburg soils. The Buse soil occupies about 56 percent of this unit and developed in loam or clay loam glacial till or in silty glacial drift. The Kranzburg soil

***Figure 4.*—Profile of Buse loam. The lime shows as white spots in the glacial till.**

occupies about 36 percent of this unit and developed in silty material or loess overlying glacial till. The depth to till is about 18 to 40 inches. The Kranzburg soil is deep and well drained. Soils of the Brookings, Parnell, and Hidewood series occupy about 8 percent.

The soils of this unit have rapid runoff that causes accelerated erosion. Terraces, vegetated waterways, and the return of all crop residue to the surface soil will help to control erosion on the cultivated fields. Most areas of these soils are cultivated and, under good management, produce fair yields of corn, small grains, and alfalfa.

Included with this mapping unit, in slight depressions and in swales, are areas of Brookings silt loam. Also included, in confined depressions and in narrow drainageways, are small areas of Parnell silty clay loam, Hidewood silty clay loam, and Hidewood silty clay loam, calcareous.

Capability unit IVe–22; windbreak suitability group 2.

Buse-Kranzburg loams, 9 to 17 percent slopes, eroded (BKD2).—This complex occurs on hilly uplands in the western part of the county. The soils are similar to Buse-Kranzburg loams, 5 to 9 percent slopes, eroded. They differ from those soils in having stronger slopes and in occupying a different proportion of the complex. Buse soils occupy about 64 percent of the area, and Kranzburg soils about 30 percent. Soils of the Brookings, Parnell, and Hidewood series occupy about 6 percent.

The soils of this unit are subject to rapid runoff and to erosion. They are used for crops and pasture, but crop yields are generally low. Under good management tame and native grasses produce good yields. Terraces, grassed waterways, and residue management help control erosion on cultivated fields. Seeding grasses, legumes, and close-growing crops protects these soils and helps to maintain the supply of organic matter.

Capability unit IVe–22; windbreak suitability group 2.

Buse-Kranzburg stony loams (5 to 17 percent slopes) (BKs).—About 54 percent of this complex is Buse soils, and about 37 percent is Kranzburg soils. Both kinds of soils are stony and somewhat excessively drained. The Buse soils are on knobs, the crest of hills, and short, steep, generally eroded slopes. The Kranzburg soils occupy the more gentle slopes. Soils of this unit are in pasture that produces good yields of grass under good management.

The surface layer of the Buse soil is calcareous loam and clay loam, about 5 inches thick. In most places the surface layer of Kranzburg soil is silty clay loam and contains no lime. Enough stones and boulders are on the surface of these soils to make the operation of farm machinery hazardous.

The subsoil of the Kranzburg soil is finer textured than the surface layer and is calcareous at a depth of about 27 inches. The Buse soil has a weakly developed subsoil that is strongly calcareous at a depth of about 20 inches.

The parent material of Buse soil is friable or firm glacial till. The Kranzburg soil formed in silty or loess-like material and is underlain by firm glacial till at a depth of 35 inches.

Brookings, Parnell, and Hidewood soils are included in some of the mapped areas and make up about 6 percent of this mapping unit. Soils of the Buse-Sioux complex are also included and make up about 3 percent.

Capability unit VIIs–81; windbreak suitability group 4.

Buse loam, 9 to 17 percent slopes (BmD).—This soil occurs in glacial till on hilly and moderately steep uplands in nearly all parts of the county. In the eastern part it occupies the slopes along well-defined drainageways. In the western part it occurs on knobs and moderately steep, short slopes. Runoff is rapid, and the soil is susceptible to erosion. If it is well managed, this soil produces good yields of pasture and hay.

The profile of this soil is like the one described for the Buse series. The content of organic matter and of nitrogen is generally low. Occasional stones on the surface may hinder the use of farm machinery.

Included in mapped areas of this soil is Kranzburg silty clay loam, 5 to 9 percent slopes, eroded, which makes up about 10 percent of the total acreage. Smaller amounts of Parnell silty clay loam and Hidewood silty clay loam are in the depressions and swales.

Capability unit VIe–22; windbreak suitability group 4.

Buse soils, steep (9 to 60 percent slopes) (BnE).—These soils are steeper than Buse loam, 9 to 17 percent slopes, and are used mostly for pasture. If they are overgrazed, erosion is likely because of the rapid runoff and unprotected surface.

The surface layer in most places is about 3 inches thick. If these soils are cultivated or eroded, yellow parent material is exposed at the surface or is mixed with the surface layer. Fertility and yields of crops and grasses are low. Although stones and pebbles are common, they do not hinder the operation of farm machinery. The steep slopes, however, are a hazard to haying machinery.

Included with the mapped areas of these soils are some areas of Buse loam, 9 to 17 percent slopes, which make up about 10 percent of the total acreage.

Capability unit VIIe–22; windbreak suitability group not assigned.

Buse stony loam, 5 to 17 percent slopes (BoD).—This soil is in rolling and hilly, morainic areas where runoff is rapid. If it is well managed, this soil will produce good pasture, which is its best use.

This soil has a profile like the one described for the Buse series, but stones and boulders are more plentiful. This soil also has more gravelly knobs than other Buse soils.

Included with this soil in mapping are areas of Buse loam, 9 to 17 percent slopes, and areas of Buse-Sioux complex, which together make up about 12 percent of the total acreage.

Capability unit VIIs–81; windbreak suitability group not assigned.

Buse-Sioux complex (5 to 17 percent slopes) (BS).—This complex consists mainly of Buse loams and Sioux gravelly loams on uplands. One large area is east of Sioux Falls. The soils in the complex are excessively drained and generally are too stony for cultivation. They are best used for pasture or for supplying gravel and sand for construction work.

The Buse soils formed in calcareous glacial till and range from loam to clay loam. The Sioux soils formed

in glacial alluvium and are shallow to calcareous gravel. Buse soils and Sioux soils generally are in about equal amounts, but this proportion may vary as much as 20 percent in some areas. Both the Buse and Sioux soils are described more fully in their series descriptions.

Included in this complex is Vienna silt loam, 5 to 9 percent slopes, eroded, which makes up about 6 percent of the total acreage.

Capability unit VIIs-87; windbreak suitability group not assigned.

Buse-Vienna loams, 5 to 9 percent slopes, eroded (BVC2).—This complex occurs on sloping, somewhat excessively drained uplands. The acreage of the Buse soil and of the Vienna soil is about equal. About 10 percent of the acreage of Vienna soil is uneroded. These soils developed in loam to clay loam glacial till. The Buse soil occurs on steeper knobs and on shorter, steeper slopes than the Vienna soil, which is in more protected areas. A large part of this unit is in crops, but yields on the Buse soil are among the lowest in the county.

The Buse soil and the Sioux soil are described more fully in their series descriptions.

Included in mapped areas of these soils are small areas of Alcester silt loam, 3 to 5 percent slopes, and of Alluvial land.

Capability unit IVe-22; windbreak suitability group 2.

Corson Series

In the Corson series are deep, well-drained, fine-textured soils that formed on uplands in clayey alluvium or fine-textured loess. These soils occur in the eastern part of the county between soils in loess and soils on lower lying glacial till. They have a high water-holding capacity and moderately slow permeability.

The surface layer is very dark gray or black, slightly acid silty clay, about 5 inches thick. This layer puddles if the soils are worked when wet.

The subsoil contains more clay than the surface layer and is more than 40 inches thick. It is hard when dry and difficult to work when wet. The upper part is nearly neutral, and the lower part is mildly alkaline.

The underlying parent material is clay in most places and is moderately alkaline. Water moves slowly in this layer.

The thickness of the surface layer ranges from 4 to 8 inches. In some areas recent deposits of loess have thinly mantled this soil. The subsoil ranges from silty clay to clay and, in most places, contains a lime zone usually below a depth of 11 inches.

The Corson soils occur with the Moody and the Crofton soils and are finer textured. They developed in clayey sediments that were deposited by wind or water whereas the Vienna soils developed in glacial till. The Corson soils have a thinner surface layer than Benclare soils and are better drained.

The Corson soils are cultivated and, if managed well, produce good yields. These soils puddle if worked when wet, and they crust and clod when they dry. Sloping Corson soils are susceptible to erosion. Corn is the main crop, though soybeans, small grains, and alfalfa are also grown.

Corson silty clay, 1 to 3 percent slopes (CoA).—This soil is on nearly level uplands. It takes in water slowly, but erosion is not a problem. It also dries slowly, puddles if it is worked when wet, and crusts and clods when it dries. Consequently, tillage and the preparation of a seedbed are difficult.

The surface layer is silty clay about 5 inches thick. The subsoil is very thick, generally contains more clay than the surface layer, and has fine, subangular blocky structure. The lower part of the subsoil is normally calcareous.

The small total acreage of this soil is used for crops. Tilth and the permeability of this soil can be improved by seeding legumes for green manure, by returning crop residue to the surface soil, and by adding organic or inorganic fertilizers.

Mapped areas of this soil include small areas of Benclare silty clay loam, poorly drained. These inclusions are in slight depressions and occupy about 5 percent of the total acreage.

Capability unit IIs-1; windbreak suitability group 3.

Corson silty clay, 3 to 5 percent slopes, eroded (CoB2).—This eroded soil is on gently sloping uplands. It is susceptible to further erosion because permeability is slow and runoff is moderately rapid.

The surface layer is silty clay, about 5 inches thick. The high clay content makes this soil hard to till. The clayey subsoil is very thick and is usually calcareous at a depth of 33 inches. The parent material is clayey, calcareous, and hard when dry.

Most of this soil is cultivated. Erosion can be controlled by building gradient terraces, tilling on the contour, contour stripcropping, grassing waterways, managing crop residue, and seeding grasses and legumes. These practices also improve permeability and tilth.

Included with mapped areas of this soil are small areas of Corson silty clay, 1 to 3 percent slopes, and on steeper slopes along drainageways, small areas of Corson silty clay, 5 to 9 percent slopes, eroded. The nearly level included soil makes up about 8 percent of the area, and the sloping soil about 4 percent.

Capability unit IIIe-1; windbreak suitability group 3.

Corson silty clay, 5 to 9 percent slopes, eroded (CoC2).—This eroded soil is on sloping uplands. It has a thinner surface layer and a less developed subsoil than Corson silty clay, 3 to 5 percent slopes, eroded, and lime is closer to the surface.

Because this soil is sloping and runoff is rapid, further erosion is likely. The use of legumes, grasses, and crop residue improves tilth and permeability. Erosion can be controlled by tilling on the contour, contour stripcropping, terracing, and grassing waterways.

Included with the mapped areas of this soil are small areas of Corson silty clay, 3 to 5 percent slopes, eroded, which makes up about 8 percent of the total acreage. Also included are a few areas of Terrace escarpments.

Capability unit IIIe-1; windbreak suitability group 3.

Crofton Series

Soils of the Crofton series are deep, silty, and excessively drained. These soils developed in strongly calcareous loess on uplands, generally on the steeper slopes in the eastern two-thirds of the county.

The surface layer is thin, dark grayish-brown to very dark grayish-brown, friable silt loam that is moderately alkaline. The structure of the surface soil is generally weak and granular.

The subsoil is silty and has weak, coarse prisms. It is grayish brown to light olive brown and moderately alkaline. It is very easy to work when dry or moist.

The parent material is silty, calcareous loess. The loess extends to a depth of about 6 feet and is underlain by glacial till.

The surface layer ranges from 2 to 6 inches in thickness and from very dark grayish brown to olive brown in color. In some places it is calcareous and contains hard concretions of lime.

These soils have rapid runoff and are likely to erode. Because they are alkaline, phosphorus is not released, and fertility is low. The water-holding capacity is good.

The Crofton soils have a thinner surface layer than the Moody and the Nora soils and less development of the profile. Lime is at or near the surface in Crofton soils, is below 30 inches in Moody soils, and is below 10 inches in Nora soils.

Because these soils generally have a thin surface layer, are low in fertility, and are very susceptible to erosion, they are not suitable for continuous crops. Terraces are needed on the gentle slopes to control runoff and erosion. Also needed are additions of nitrogen and phosphate. Fair yields of corn, small grains, and alfalfa can be produced on the gentler slopes under good management. The steep slopes are in pasture. Stands of grass are excellent in areas that are not overstocked and are otherwise managed well.

Crofton silt loam, 5 to 9 percent slopes, eroded (CrC2).—This soil is on sloping, loessal uplands that have rapid runoff. It is generally on windswept ridges and unprotected slopes where sheet erosion is moderate. This soil is in the eastern two-thirds of the county in a small total acreage. Most of this soil is cultivated.

The surface layer is thin, friable, dark grayish-brown to very dark grayish-brown silt loam that is moderately alkaline. The subsoil is a friable, grayish-brown to light olive-brown silt loam that has a weak, coarse, prismatic structure and is permeable to water and roots. The subsoil is mildly or moderately alkaline. The parent material is moderately alkaline, light yellowish-brown to olive-brown silt loam. Many lime concretions are in the subsoil and the parent material.

The organic-matter content of this soil is low or fairly low. Yields of crops vary from low to high, according to the kind of management. To help control erosion, this soil needs contour tillage, contour stripcropping, grassed waterways, terraces, and management of crop residue.

Nora-Crofton silt loams, 5 to 9 percent slopes, eroded, are included in the mapped areas of this soil and make up about 12 percent of the total acreage.

Capability unit IVe–22; windbreak suitability group 2.

Crofton silt loam, 9 to 17 percent slopes, eroded (CrD2).—This moderately steep soil has more rapid runoff than Crofton silt loam, 5 to 9 percent slopes, eroded, and is moderately eroded. Most of its small total acreage is cultivated, and yields are low.

The surface layer is friable, grayish-brown silt loam, about 3 inches thick. This layer is moderately alkaline, and lime concretions are near or at the surface. The subsoil is silt loam of coarse and medium, prismatic structure. The loessal parent material is exposed in spots and consists of calcareous, light yellowish-brown to olive-brown silt loam.

This soil is low in organic-matter content. It has good permeability to water and to roots, and it responds to good management. Terraces and a cropping sequence that includes grasses and legumes help to control runoff and erosion and to improve tilth. Other practices that help are grassing waterways, contour tillage, contour stripcropping, and management of crop residue.

Nora-Crofton silt loams, 9 to 17 percent slopes, eroded, are included in the mapped areas of this soil and make up about 9 percent of the total acreage.

Capability unit IVe–22; windbreak suitability group 2.

Crofton silt loam, 17 to 30 percent slopes (CrE).—This soil is steeper than the other Crofton soils in this county, and more of its loessal parent material is exposed. Runoff is more rapid. Some areas on slopes less than 20 percent are cultivated. Erosion is moderate to severe on cultivated fields and on the overgrazed pastures.

The surface layer, about 2 inches thick, is friable, dark grayish-brown to very dark grayish-brown silt loam that is moderately alkaline. More lime concretions are on the surface than are on that of other Crofton silt loams.

Because of the steep slopes, low fertility, and susceptibility to erosion, this soil is best used for hay or pasture. Yields of grass are good under appropriate management.

Capability unit VIe–22; windbreak suitability group 2.

Dimmick Series

In the Dimmick series are poorly drained, dark-colored, fine-textured soils that occur mainly in slight depressions and in wet, flat areas of the flood plain along the Big Sioux River. These soils formed in sediments that were recently deposited by floodwater. They have very slow permeability and a high water table.

The surface layer, about 5 inches thick, is a black silty clay or clay of granular structure. It contains large amounts of undecomposed organic matter.

The subsoil is black to a depth of about 30 inches. It is clayey, is usually wet, and is very hard to work when dry. In most places the underlying material is dark-gray clay that seldom is dry. In some places the fine-textured sediments extend to a depth of more than 4 feet, where they may be underlain by stratified silt, sand, and gravel.

Dimmick soils have a high water table. They are frequently flooded and receive fresh sediments from each flood. These soils contain a large amount of organic material. Lime is at a depth of less than 30 inches in some places.

The poorly drained Dimmick soils are more mottled than the somewhat poorly drained Luton soils, and, unlike the very poorly drained Rauville soils, do not occur in old river channels.

Dimmick soils are best used for hay and produce high yields of grasses. If the soils are pastured and not appropriately managed, they puddle. Dikes, levees, and drainage systems are needed to control excess water.

Dimmick clay (0 to 2 percent slopes) (Dm).—This soil occurs in level areas and in slight depressions on flood plains. Surface and internal drainage are slow. Farming this soil is difficult because it occurs as small areas in cultivated fields of Luton soils. Some of these areas can be improved by digging drainage ditches, by laying tile drains, or by building dikes. Then, adapted grasses should be reseeded.

Luton clay is included in the mapped areas of this soil and makes up about 10 percent of the total acreage.

Capability unit Vw–11; windbreak suitability group not assigned.

Egeland Series

Soils of the Egeland series are deep, well drained, and medium textured. These soils are on high terraces and uplands on the eastern side of the Big Sioux River and of Skunk Creek.

The surface layer is a very dark gray or black loam, about 9 inches thick. It is granular, friable, and is easily worked. It is slightly acid or neutral.

The subsoil is about 29 inches thick and contains more sand than the surface layer. Below a depth of 15 inches the subsoil is dark-brown sandy loam and loamy sand. It has weak, coarse, prismatic structure that breaks to granular. This layer is friable when moist; when dry, it is soft or slightly hard and can be easily worked.

The parent material consists of silt and sand that blew onto the terraces and uplands from the bottoms. Underlying the parent material are sand and gravel that appear to have been deposited by water.

Egeland soils are well drained and moderately to rapidly permeable. Their capacity to hold available water is lower than that in most soils of the county.

The Egeland soils have a sandier subsoil than the Flandreau and the Fordville soils but are not so sandy as the excessively drained Maddock soils.

These soils take in water readily, but their water-holding capacity is low, and they are somewhat droughty. Organic-matter content is low to medium, and additions of nitrogen and phosphate are needed. Most crops common in the area can be grown.

Egeland loam, 1 to 3 percent slopes (EgA).—This soil occurs on nearly level uplands and terraces. It takes in water readily and has slow runoff. Most areas of this soil are cultivated and produce fair to good yields under good management.

The surface layer is loamy and about 9 inches thick. It is easy to work but blows if it is unprotected. The subsoil is sandier than the surface layer and is underlain by sand that allows water to move readily through it. The permeability of the subsoil is moderately rapid. Lime occurs at a depth of 38 inches.

This soil is droughty and susceptible to wind erosion. Careful management of crop residue helps to control erosion. Flandreau loam, 1 to 3 percent slopes, is included with the mapping units of this soil and makes up about 10 percent of the total acreage.

Capability unit IIIs–3; windbreak suitability group 2.

Egeland loam, 3 to 5 percent slopes (EgB).—This soil occurs on gentle slopes of uplands and terraces. After heavy rains or the melting of deep snow, there is some runoff. Most areas of this soil are cultivated and produce fair to good yields under good management. Crops common in the area are grown.

The surface layer is loamy and about 7 inches thick. It is easy to work, but because its material breaks down easily, it is susceptible to wind erosion. The subsoil is sandier than the surface layer and is underlain by loose sand. Permeability is moderately rapid, and the water-holding capacity is moderately low. Lime occurs at a depth of 38 inches.

Practices needed to control erosion are tilling on the contour, contour stripcropping, terracing, and managing crop residue. Included with the mapped areas of this soil is Egeland loam, 1 to 3 percent slopes, which makes up about 9 percent. Also included is Flandreau loam, 3 to 5 percent slopes, which makes up about 6 percent.

Capability unit IIIe–3; windbreak suitability group 2.

Egeland loam, 5 to 9 percent slopes, eroded (EgC2).—This soil occurs mostly on sloping uplands. It is similar to Egeland loam, 3 to 5 percent slopes, but has a thinner surface layer and is shallower to sand.

Although this soil is best suited to small grains, most of it is planted to crops common in the area. Yields are fair but can be improved by management that helps to control erosion and to maintain the supply of organic matter.

Practices needed to control erosion are tilling on the contour, contour stripcropping, terracing, and managing crop residue. Included in the mapped areas of this soil is Maddock loamy fine sand, 5 to 9 percent slopes, eroded, which makes up about 10 percent of the total acreage.

Capability unit IIIe–3; windbreak suitability group 2.

Estelline Series

In the Estelline series are deep, well-drained, medium-textured soils over sand or gravel. These soils developed in silty material that was deposited by wind or by water. They occur on level and gently sloping stream terraces or on glacial outwash of the uplands. The larger areas of these soils are on stream terraces, but these areas are not so extensive as are nearby areas of Fordville soils.

The surface layer is usually a very dark brown to black silt loam, about 7 inches thick. It is friable and easy to work. This dark surface layer grades to a lighter colored silty clay loam subsoil. The subsoil has moderate, prismatic structure and is slightly hard when dry but breaks up easily when moist. Below a depth of 46 inches, the subsoil is abruptly underlain by sand or gravel. A lime zone occurs in the sand and gravel in most places.

These well-drained soils are fertile. Although the level areas are not susceptible to erosion, the gentle slopes are slightly susceptible. These soils have a good water-holding capacity above the sand and gravel. Except in long dry periods, crop yields are generally good.

Estelline soils are deeper to sand or gravel than Fordville soils. They differ from Egeland soils in having a finer textured subsoil over sand and gravel. They do not have a glacial till substratum like that in Kranzburg soils.

Permeability of the Estelline soils is moderate above the layer of sand and gravel but is moderately rapid in

the lower part of the profile. All crops common in the area can be grown and generally produce good yields.

Estelline silt loam, 0 to 2 percent slopes (EsA).—This soil occurs on nearly level uplands and on stream terraces east of the Big Sioux River, of Skunk Creek, and of Split Rock Creek. This soil takes in water readily and has slow runoff.

The profile of this soil is like the one described for the series.

This soil generally is not susceptible to erosion, but it is likely to be droughty when there is not enough rain. This droughtiness can be reduced by maintaining a high organic-matter content through the use of grasses, legumes, and crop residue. Corn, small grains, and alfalfa are the main crops. Yields are generally good except in long dry periods. Flandreau loam, 1 to 3 percent slopes, is included in many of the areas mapped and makes up about 13 percent of the acreage. Also in the mapped areas are small areas of Athelwold silt loam in the swales.

Capability unit IIs–25; windbreak suitability group 2.

Estelline silt loam, 3 to 4 percent slopes (EsB).—This gently sloping soil is on uplands and stream terraces. Most of it is on ridgetops and side slopes. It generally occurs on the east side of the larger streams in the eastern two-thirds of the county. Unprotected slopes are likely to erode.

This soil has a profile like the one described for the series.

Erosion can be controlled by tilling on the contour, contour stripcropping, terracing, grassing waterways, and managing crop residue. Fertilizers should be used where soil tests show they are needed. Corn, small grains, and alfalfa are the main crops and generally produce good yields except in dry seasons.

About 8 percent of the total acreage mapped is Flandreau loam, 3 to 5 percent slopes. About 4 percent is Egeland loam, 3 to 5 percent slopes.

Capability unit IIe–25; windbreak suitability group 2.

Flandreau Series

In the Flandreau series are deep, well-drained, friable soils that formed in loess over sand. The sand is at a depth of 33 to 50 inches. These soils occur on nearly level to sloping uplands east of Skunk Creek and the Big Sioux River.

The surface layer is a very dark grayish-brown to black, neutral loam, about 7 inches thick. When it is dry or moist, this layer is soft, very friable, and easy to work.

The subsoil is generally silty. It contains slightly more clay than the surface layer and is lighter colored. It has weak, prismatic structure, is easy to work, and is neutral.

The underlying material is sand that was deposited by wind or by water. Although the sand is multicolored, its basic color is olive brown. This material is loose when dry or moist. It is moderately alkaline.

The surface layer ranges from loam to silt loam in texture and from 5 to 9 inches in thickness. The subsoil has weak to moderate structure and, in some places, is clay loam. In some areas the underlying sand is at a depth of more than 40 inches. In most places, lime is in the sand, but in some places, it is in the lower subsoil.

These well-drained soils take in water readily and have good water-holding capacity. Runoff is slow on nearly level areas but increases with increasing steepness. The erosion hazard is slight or moderate.

Their sandy substrata differentiates the Flandreau soils from the Moody soils and the Kranzburg soils. The substratum of the Moody soils is loess, and that of the Kranzburg soils is glacial till. Flandreau soils have more silt in the surface layer than the coarser textured Egeland soils, and they are slightly more developed in the subsoil. Most areas of these soils are cultivated and produce good yields of corn, small grains, and alfalfa. Other crops common in the area also can be grown and, under good management, produce excellent yields.

Flandreau loam, 1 to 3 percent slopes (FaA).—This nearly level soil is on uplands, where it formed in windblown silt that is about 36 inches thick over sand. This soil is used mostly for corn, small grains, and alfalfa. Yields are good if the soil is managed well.

This soil has a profile like the one described for the series. Erosion is not a problem. Although this soil is droughty in periods of low rainfall, the droughtiness can be reduced by using grasses, legumes, and crop residue to maintain a high organic-matter content.

Areas of this soil on the map include some Moody silty clay loam, 1 to 3 percent slopes, and Egeland loam, 1 to 3 percent slopes. The Moody soil makes up about 8 percent of the area, and the Egeland soil about 7 percent.

Capability unit IIs–25; windbreak suitability group 2.

Flandreau loam, 3 to 5 percent slopes (FaB).—This soil occurs on gently sloping uplands. It is in windblown silt that is about 36 inches thick over sand. It is easily tilled and produces good yields of corn and small grains if it is managed well. Although its water intake is moderate, this soil is likely to erode during intense rains. It is somewhat droughty during periods of low rainfall.

The profile of this soil is somewhat similar to the one described for the series. The surface layer and subsoil are thinner, however, and the lower part of the subsoil contains a lime zone in some places.

Erosion can be controlled by tilling on the contour, contour stripcropping, terracing, grassing waterways, and managing crop residue. Fertilizers should be used where soil tests show they are needed.

Moody silty clay loam, 3 to 5 percent slopes, makes up about 8 percent of the total acreage mapped as this soil, and Egeland loam, 3 to 5 percent slopes, about 7 percent.

Capability unit IIe–25; windbreak suitability group 2.

Flandreau loam, 3 to 5 percent slopes, eroded (FaB2).—This soil has a thinner surface layer than Flandreau loam, 3 to 5 percent slopes, and in some places the subsoil material is at the surface. Erosion has reduced yields. This soil may be droughty in the growing season if there is not enough rain.

The surface layer is a dark grayish-brown loam about 5 inches thick. It is soft, friable, and easy to work. The subsoil is slightly finer textured than the surface layer. The underlying material is sandy and moderately alkaline.

Good management is needed to maintain and increase the organic-matter content. This management provides

contour tillage, contour stripcropping, terraces, grassed waterways, and management of crop residue. Fertilizers should be used where soil tests show they are needed.

Included with mapped areas of this soil are small areas of Flandreau loam, 3 to 5 percent slopes, and of Egeland loam, 3 to 5 percent slopes. The Flandreau soil makes up about 9 percent of the total acreage, and the Egeland soil about 5 percent.

Capability unit IIIe-2; windbreak suitability group 2.

Flandreau loam, 5 to 9 percent slopes, eroded (FaC2).—This sloping soil has more runoff and erosion than Flandreau loam, 3 to 5 percent slopes. More soil has been lost than on the less eroded Flandreau soils; consequently, crop yields are less.

The profile of this soil differs somewhat from the one described for the series. The surface layer is lighter colored and thinner, and in some places, the subsoil contains lime in the lower part. Sand occurs at a depth of about 33 inches.

Good management is needed to maintain and increase the organic-matter content and to control erosion. This management provides these practices: Tilling on the contour, contour stripcropping, terracing, grassing of waterways, fertilizing, and managing crop residue.

Included with mapped areas of this soil and totaling about 10 percent of the total area are Egeland loam, 5 to 9 percent slopes, eroded, and Nora-Crofton silt loams, 5 to 9 percent slopes, eroded.

Capability unit IIIe-2; windbreak suitability group 2.

Fordville Series

In the Fordville series are somewhat excessively drained to well-drained loamy soils that formed in water-deposited sediments. In some areas the sediments have been reworked by wind. Fordville soils occur on nearly level to gently sloping stream terraces and on glacial outwash in the uplands. In most places they are 10 to 36 inches deep to gravel.

The surface layer is a dark-gray to black, neutral loam, about 8 inches thick. This layer is easy to work.

The subsoil is very dark gray to olive brown and is about 20 inches thick. In most places the subsoil is clay loam in the upper part and loam in the lower part. This layer is easy to work if it is not dry. It is mildly alkaline in the upper part but moderately alkaline in the lower part. Underlying the subsoil is glacial outwash that consists of loose, stratified sand and gravel. It is strongly alkaline in most places.

The depth to gravel ranges from 10 to 36 inches but in most places is more than 18 inches. The surface layer is generally loam or silt loam, but in some places it is sandy and gravelly. Lime generally accumulates in the lower subsoil in areas where the depth to gravel is greater than 30 inches. In some places where the depth to gravel is less than 30 inches, lime is in the underlying gravel and sand. The subsoil generally has weak, coarse, prismatic structure, but in some places this structure is moderate, coarse, and prismatic.

These well-drained soils have fair to moderate natural fertility, but are somewhat droughty. Their water-holding capacity is low to fair. Water is available for plants only in layers above the sand and gravel. These soils blow if their surface is not protected by growing plants.

The Fordville soils are 10 to 36 inches to gravel whereas the Estelline soils are 36 inches or more to sand and gravel. The Sioux soils are less that 10 inches deep to gravel. Fordville soils are finer textured than the Hecla soils.

Fordville soils are somewhat droughty. Yields of corn, small grains, and alfalfa are fair, but under good management yields can be increased. Nutrients shown to be needed are nitrogen and phosphorus.

Industrial plants and homes are being built in a large area of these soils west of Sioux Falls.

Fordville loam, 1 to 3 percent slopes (WeA).—This soil occurs on nearly level stream terraces and on glacial outwash of the uplands. Runoff is moderate. Extensive areas are on the stream terraces along the Big Sioux River and Skunk Creek.

The profile of this soil is the same as the one described for the series.

Most of this soil is cultivated; it produces fair yields of corn, small grains, and alfalfa. Because it is droughty, this soil is susceptible to wind erosion if it is not protected. Practices needed include wind stripcropping, growing of cover crops, and management of crop residues. Most areas are suitable for irrigation.

Included in mapped areas of this soil are Fordville loam, 3 to 5 percent slopes, and Athelwold silt loam. The Fordville soil makes up about 5 percent of the total acreage and the Athelwold soil about 5 percent.

Capability unit IIIs-5; windbreak suitability group 2.

Fordville loam, 3 to 5 percent slopes (WeB).—This inextensive soil occurs on stream terraces and on the glacial outwash of the uplands. It has less water-holding capacity and is droughtier than Fordville loam, 1 to 3 percent slopes. Runoff is moderate, and erosion is a problem.

The profile of this soil is similar to that described for the series, but the surface layer and subsoil are thinner.

Most of this inextensive soil is cultivated, but it produces lower yields than Fordville loam, 1 to 3 percent slopes. To control erosion, use these practices: Tilling on the contour, contour stripcropping, and returning crop residues to the surface soil.

In areas mapped as this soil are smaller areas of Fordville loam, 1 to 3 percent slopes, and of Sioux loam. The Fordville soil makes up about 8 percent of the area, and the Sioux soil about 5 percent.

Capability unit IIIe-5; windbreak suitability group 2.

Hamar Series

Soils of the Hamar series are somewhat poorly drained and sandy. In this county these soils occur only in the Hecla-Hamar complex in the swales and depressions on the higher flood plains or stream terraces. The main area is north of Sioux Falls on the east side of the Big Sioux River. Hamar soils occupy about 25 percent of the complex.

The surface layer is dark-gray to black, friable loam, about 12 inches thick. It works easily if it is not too wet. The subsoil is dark grayish-brown sandy loam mottled with many shades of yellow and reddish brown. Mottling indicates that this layer is wetter than the surface layer. The underlying material is stratified sand, gravel, and

clay and is usually very wet. This material is multicolored, but gray and brown predominate.

The surface layer ranges from loam to sandy loam. Mottles in the subsoil range from faint to prominent and vary in color and in abundance. If clayey material is present in the lower substratum, water may accumulate after intense rains to form a perched water table. Lime is sometimes present in the lower part of the subsoil.

Because the Hamar soils are sometimes wet, they may not be suitable for cultivation. Crop yields, however, are good in areas where natural or constructed surface drains are efficient enough to permit these soils to be cultivated. Because of their position, however, these soils receive large deposits of sediment.

The Hamar soils are more poorly drained than the Hecla soils. They are better drained and coarser textured throughout than the Dimmick soils. The Hamar soils are more poorly drained than the Athelwold soils and have a coarser textured surface layer.

Although these soils are generally cultivated, wetness sometimes prevents the harvest of crops. Yields of corn and of small grains, the main crops, are good when these crops can be harvested. Alfalfa yields vary according to the degree of wetness.

Hecla Series

The Hecla series consists of deep, moderately well drained, sandy soils that developed in sediments laid down by water and reworked by wind. These soils are nearly level to gently sloping and somewhat hummocky. They are on high bottoms or stream terraces, mainly along the east side of the Big Sioux River, north of Sioux Falls. They are not very extensive. In Minnehaha County, Hecla soils are intermingled with Hamar soils and are mapped with them in a complex.

The surface layer of Hecla soils is grayish-brown to black sandy loam, about 9 inches thick. This material breaks up easily and blows if it is not protected. The subsoil is dark grayish-brown sandy loam and loamy sand and has many, prominent mottles of gray, brown, and yellow in the lower part. This mottling indicates wetness. Underlying the subsoil are stratified sands that were deposited by water and seldom are dry except in the higher positions.

The surface layer ranges from black to grayish brown in color and from 6 to 10 inches in thickness. A lime zone is generally at a depth of 24 inches, but in some places it is in the lower part of the subsoil. The underlying material contains fine and coarse sand and fine gravel.

The Hecla soils have moderately rapid permeability, a fair water-holding capacity, and a low to moderate organic-matter content. They are very susceptible to wind erosion.

Hecla soils are moderately well drained whereas Maddock soils are excessively drained and Egeland soils are well drained. The Hecla soils are coarser textured throughout than the Egeland soils. Most of these soils are cultivated.

Hecla-Hamar complex (0 to 5 percent slopes) (HH).—This mapping unit is 60 percent Hecla sandy loam and about 25 percent Hamar loam. Each of these soils has been described. The Hecla soil blows if it is not protected, but the Hamar soil is in lower areas and is not susceptible to erosion. The Hecla soil has moderately rapid permeability, low water-holding capacity, and low to medium organic-matter content. The Hamar soil is more poorly drained than the Hecla soil. Crop yields occasionally may be lowered on the Hamar soil because of wetness. Erosion can be controlled by wind stripcropping and managing crop residue.

About 8 percent of the total acreage mapped is Estelline silt loam, 0 to 2 percent slopes, and about 7 percent is Egeland loam, 1 to 3 percent slopes.

Capability unit IIIs-3; windbreak suitability group 1.

Hidewood Series

Soils of the Hidewood series are deep, moderately fine textured, and somewhat poorly drained. These soils are in swales, in depressions, and at the heads of drainageways where they formed in sediments washed from adjacent uplands.

The surface layer is very dark gray to black silty clay loam, about 15 inches thick. This layer puddles if worked when it is wet, and it is blocky and hard to work when it is dry.

The subsoil is silty clay loam, about 3 feet thick. It is very dark grayish brown to black in the upper part and pale yellow to light olive brown in the lower part. The subsoil is hard when dry and difficult to work when wet. Mottles of gray, yellow, and brown indicate that this layer is wetter than the surface layer.

Underlying the subsoil is glacial till or wind-deposited silt. In some places a layer of sand or gravel separates the loamy subsoil from the glacial till. The underlying material is more mottled and is wetter than the subsoil. This material contains lime in most places.

The surface layer ranges from 10 to 18 inches in thickness and is calcareous in places. Large areas that have a calcareous surface layer are mapped as a separate unit. The depth to lime varies from place to place. The mottles in the subsoil vary in abundance and in distinctness.

The Hidewood soils contain a good supply of organic matter. Because of their position, water runs onto these soils and deposits sediment. The soils are not so well drained as the Trent and Brookings soils, but they are better drained than the Parnell soils.

Most areas of Hidewood soils are cultivated, but yields vary because of the varying degree of wetness. If these soils are adequately drained, they produce good to excellent yields of corn and small grains. If they are in hay or pasture, they produce excellent yields of grass.

Hidewood silty clay loam (0 to 2 percent slopes) (Hw).—This soil is in swales, in depressions, and at the head of drainageways. Because of its position, it receives water in addition to that received in precipitation. It is scattered in small areas throughout the county.

The profile of this soil is like the one described for the series.

If the soil is adequately drained, it produces excellent yields of corn, small grains, and alfalfa. Yields of pasture and hay are also excellent under good management. Drainage, bedding, and other practices can be used to reduce the flooding hazard.

Included in mapped areas of this soil is Hidewood silty clay loam, calcareous, which makes up about 8 percent of the total acreage. Also included are Brookings silt loam in the western part of the county and Trent silty clay loam in the eastern two-thirds. These soils together make up about 6 percent of the total acreage. Also included are a few wet areas and slickspots.

Capability unit IVw–1; windbreak suitability group 5.

Hidewood silty clay loam, calcareous (0 to 2 percent slopes) (Hy).—This soil is limy at the surface but is similar to Hidewood silty clay loam in other respects. It is nearly level and occurs in swales, in depressions, and in broad drains that have slow surface runoff. It is mainly in the northwestern part of the county and is less extensive than Hidewood silty clay loam.

The profile of this soil is like the one described for the series, except that lime is at or near the surface.

If this soil is adequately drained, it produces excellent yields of corn, small grains, and alfalfa. Yields of grass are also excellent if management is good.

Included in mapped areas of this soil are areas of Hidewood silty clay loam and of Trent silty clay loam. The Hidewood soil makes up about 10 percent of the total acreage, and the Trent soil about 5 percent. Also included are a few wet spots and a few slickspots.

Capability unit IVw–1; windbreak suitability group 5.

Kranzburg Series

In the Kranzburg series are deep, well-drained, silty soils that formed in loess or in loesslike material over glacial till (fig. 5). These soils occur on nearly level to sloping uplands in the western one-third of the county and in scattered areas in the northeastern part. The total acreage is large.

The surface layer is dark-gray, acid silty clay loam, about 5 inches thick. It is soft and friable when dry or moist and is easy to work.

The subsoil is dark grayish-brown, light olive-brown to dark-brown silty clay loam, about 30 inches thick. This layer contains slightly more clay than the surface layer. In most places the upper part of the subsoil is in loess. The lower part is generally in clay loam glacial till and is difficult to dig. The subsoil is neutral in the upper part and mildly or moderately alkaline in the lower part.

The underlying material is grayish-brown to light olive-brown clay loam glacial till. It is moderately alkaline.

The thickness of the surface layer and silty subsoil above glacial till varies from place to place. The depth to lime ranges from 18 to 27 inches. Whether the lime is in the silty material or in the glacial till depends on the thickness of the silty material over the till.

These well-drained soils are moderately high to high in fertility and are high in water-holding capacity. Runoff is moderate on nearly level areas but increases on slopes and, if uncontrolled, may cause these soils to erode.

The Kranzburg soils have a lower subsoil developed in glacial till whereas the Moody soils have a profile developed in wind-deposited silt. The Kranzburg soils contain less clay than the Sinai soils. Also, they take in water faster and are more permeable than the Sinai soils. Kranzburg soils are better drained than the Hidewood and the Parnell soils.

Most of the acreage is cultivated. These soils produce good to excellent yields of corn, small grains, and alfalfa under good management. Other crops common in the area can be grown. Sloping Kranzburg soils erode if they are not well managed.

Kranzburg-Beadle silty clay loams, 1 to 3 percent slopes (KBA).—This mapping unit consists of about 65 percent Kranzburg silty clay loam and about 25 percent Beadle silty clay loam. Runoff is slow, and except on long slopes, erosion is not a problem. Most of the acreage is cultivated and produces good to excellent yields of corn, small grains, and alfalfa under good management. Other crops common in the area are grown.

Beadle soils have been described, and Kranzburg silty clay loam, 1 to 3 percent slopes, is described later in this section.

Mechanical practices generally are not needed to control erosion. These soils can be protected and their tilth improved by seeding grasses and legumes; by adding mineral fertilizers, barnyard manure, or both; and by returning all crop residue to the surface soil.

Figure 5.—**Kransburg silty clay loam profile. This is a deep, dark-colored, friable soil. It will produce good to excellent yields under good management.**

Included with the mapped areas of these soils is Brookings silt loam, which makes up about 10 percent of the total acreage.

Capability unit I–2; windbreak suitability group 2.

Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes (KBB).—This mapping unit consists of about 64 percent Kranzburg silty clay loam and about 30 percent Beadle silty clay loam. Runoff is moderate, and where it is not controlled, erosion is likely. Most of the acreage is cultivated and, under good management, produces good yields of corn, small grains, and alfalfa. Other crops common in the area are also grown.

Beadle soils have been described, and Kranzburg silty clay loam, 3 to 5 percent, is described later in this section.

The organic-matter content needs to be increased and the increase maintained. Practices to control erosion include tilling on the contour, contour stripcropping, terracing, grassing of waterways, managing crop residue, and fertilizing.

Included in this mapping unit is Brookings silt loam, which makes up about 6 percent of the total acreage.

Capability unit IIe–2; windbreak suitability group 2.

Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes (KBC).—This mapping unit consists of about 59 percent Kranzburg silty clay loam and about 30 percent Beadle silty clay loam. Runoff is rapid, and if it is not controlled, these soils are likely to erode. Most areas of these soils are cultivated and, under good management, produce good yields of corn, small grains, and alfalfa. Other crops common in the area are grown.

Beadle soils have been described, and Kranzburg silty clay loam, 5 to 9 percent slopes, is described later in this section.

Practices to control erosion are: Tilling on the contour, contour stripcropping, terracing, grassing of waterways, managing crop residue, and fertilizing.

Brookings silt loam and Hidewood silty clay loam are included in areas of this mapping unit. Brookings soil makes up about 6 percent of the unit, and the Hidewood soil about 5 percent.

Capability unit IIIe–2; windbreak suitability group 2.

Kranzburg-Buse loams, 3 to 5 percent slopes (KBuB).—This mapping unit consists of about 57 percent Kranzburg silty clay loam and about 30 percent Buse loam. Runoff is moderate, and erosion is a problem if it is not controlled. Most areas of these soils are cultivated and, under good management, produce fair to good yields of corn, small grains, and alfalfa. Other crops common in the area are grown.

Buse soils have been described, and Kranzburg silty clay loam, 3 to 5 percent slopes, is described later in this section.

The Kranzburg soil is deep, well-drained silty clay loam that formed in loess or silty material over glacial till. It occurs on the undulating positions. The Buse soil is thin, somewhat excessively drained loam or clay loam that formed in silty material or glacial till. It occurs as eroded bands around the depressions, on knobs, or on the short, eroded slopes. The Buse soil has a thinner surface layer and a less devloped subsoil than the Kranzburg soil, and it is shallower to lime.

The organic-matter content of these Buse and Kranzburg soils should be increased, and the increase maintained. Also needed, to control erosion, are contour tillage, contour stripcropping, terraces, grassed waterways, and management of crop residue.

As much as 8 percent of any area mapped is Brookings silt loam, and about 5 percent is a Hidewood soil. Also included are small pockets of Sioux gravelly loam.

Capability unit IIIe–23; windbreak suitability group 2.

Kranzburg silty clay loam, 1 to 3 percent slopes (KrA).—This extensive soil occurs on nearly level, silty uplands, mainly in the western part of the county. Runoff is slow, and erosion is a problem only on the long slopes. Most of this soil is cultivated and, under good management, produces good to excellent yields of corn, small grains, and alfalfa. Other crops common in the area are grown.

The surface soil is dark-gray to black, friable silty clay loam, about 7 inches thick. The subsoil is about 30 inches thick. The upper part of the subsoil is silty clay loam that formed in silty material in most places. The lower part is generally in glacial till and is of silty clay loam or clay loam texture. The till is less friable than the silty material in the upper part of the subsoil. Lime usually occurs in the lower subsoil.

Erosion can be controlled and the supply of organic matter maintained by seeding grasses and legumes; by adding mineral fertilizer, barnyard manure, or both; and by returning all crop residue to the surface soil.

Brookings silt loam and Hidewood silty clay loam are included in mapped areas of this soil. The Brookings soil makes up about 9 percent of the total acreage, and the Hidewood soil about 5 percent.

Capability unit I–2; windbreak suitability group 2.

Kranzburg silty clay loam, 3 to 5 percent slopes (KrB).—This extensive soil occurs on gently sloping and undulating, silty uplands in the western part of the county. Runoff is moderate and erosion is a problem. This soil is used mostly for crops and produces good yields of corn, small grains, and alfalfa under good management. Other crops common in the area are also grown.

This soil has a thinner surface layer and subsoil than Kranzburg silty clay loam, 1 to 3 percent slopes. Those layers in the two soils are similar in color, texture, depth to lime, and workability.

The organic-matter content needs to be increased and the increase maintained. Practices needed to control erosion include tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue. Fertilizers should be added where soil tests show that they are needed.

Included in mapped areas of this soil is Brookings silt loam, which makes up about 7 percent of the total acreage. Hidewood silty clay loam makes up about 4 percent.

Capability unit IIe–2; windbreak suitability group 2.

Kranzburg silty clay loam, 5 to 9 percent slopes, eroded (KrC2).—This extensive soil occurs on sloping and rolling silty uplands, mainly in the western part of the county. Runoff is moderately rapid, and much of this soil is eroded. This soil has more pebbles and stones on and in it than have other Kranzburg soils. Nevertheless, most of this soil is cultivated and, under good management, produces fair to good yields of corn, small grains, and alfalfa.

The surface layer is dark-gray, very dark grayish-brown, and light olive-brown silty clay loam, about 5 inches thick. This light color indicates that the organic-matter content is low to medium, and that, because of erosion, the subsoil is mixed with the surface layer. The subsoil and underlying material are described in the description for the Kranzburg series. The depth to lime is usually 18 to 27 inches.

The organic-matter content needs to be increased and the increase maintained. This soil can be protected from erosion by tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue. These practices also help to maintain the organic-matter content.

Included with mapped areas of this soil is Kranzburg silty clay loam, 3 to 5 percent slopes, which makes up about 7 percent of the total acreage. The Buse soils make up about 5 percent, and Brookings silt loam, about 3 percent.

Capability unit IIIe-2; windbreak suitability group 2.

Lamoure Series

In the Lamoure series are deep, moderately fine textured, somewhat poorly drained soils that are flooded frequently and have a water table that seasonally fluctuates. In this county these soils formed in alluvium on the flood plains of the Big Sioux River and of Skunk, Beaver, Split Rock, and Pipestone Creeks.

The surface layer is a very dark gray to black silty clay loam, about 7 to 15 inches thick. It is easy to work when the moisture content is good, but it generally clods if worked when dry and puddles if worked when wet. This layer is calcareous in most places.

The subsoil extends to a depth of 40 inches or more. It is very dark gray to gray in color and ranges from silt loam to silty clay loam in texture. The gray color indicates that this layer is wet for long periods. Strong to violent effervescence in this layer indicates that it is very calcareous.

In some places water-laid sand and gravel are below a depth of 40 inches. This layer is limy and is moist or wet most of the time.

The Lamoure soils are calcareous at the surface in most places, but in many places lime does not occur above a depth of 16 inches. The subsoil is generally gray, but on the better drained sites it is brownish gray.

Lamoure soils are flooded frequently and dry out slowly when the water table is high. Because these soils are low, they may be scoured by floods or covered by sediments of silt or sand. The new deposits keep fertility high. These soils have good water-holding capacity.

The Lamoure soils are in coarser textured alluvium than the Luton soils and are calcareous nearer the surface. They are better drained than the clayey Dimmick soils but are not so well drained as the silty La Prairie soils.

Lamoure soils are used for pasture and for crops. Well-managed pasture produces high yields, but grazing on these soils when they are wet puddles them and reduces yields. These soils can be cropped if they are protected from floods by dikes, diversions, or drains. Corn and soybeans are the best suited crops and produce good to excellent yields. Other crops can be grown, but usually the soil does not dry out early enough in the spring for the preparation of a good seedbed and for planting these crops.

Lamoure silty clay loam (0 to 2 percent slopes) (La).—This soil is in a small total acreage on nearly level flood plains. Because runoff and internal drainage are moderately slow, farming is difficult. Nevertheless, about 70 percent of this soil is in cultivated crops and 30 percent in pasture.

This soil has a profile like the one described for the series.

Flooding is frequent on this soil, and the water table fluctuates. The damage from floods can be reduced by digging open ditches or laying tile, by bedding, and by digging diversion ditches. Catch crops may have to be substituted for regular crops in areas that stay wet late in spring.

Included in mapped areas of this soil are Luton clay and Alluvial land. The Luton clay makes up about 10 percent of the total acreage, and the Alluvial land, about 4 percent.

Capability unit IVw-11; windbreak suitability group 2.

La Prairie Series

Soils of La Prairie series are deep, moderately well drained, and medium textured. These soils formed in recently deposited alluvium in small areas on nearly level high bottoms, in swales, and in slight depressions.

The surface layer is very dark grayish-brown to black silt loam, about 7 inches thick. It is granular and slightly acid.

The subsoil is very dark gray to black loam to a depth of about 45 inches. It has weak, prismatic structure and is easy to dig when dry or moist. It is neutral in the upper part and moderately alkaline in the lower part.

The underlying material is sandy in most places, but in some places it contains stratified silt and sand or a buried soil profile. It is strongly alkaline.

These soils take in water easily and are moderately permeable. They are flooded occasionally by runoff from adjacent areas. These soils are moderate to high in natural fertility and receive fresh sediments containing plant nutrients from each flood.

La Prairie soils are coarser textured than the Luton soils. Drainage is better than in the Lamoure soils, and leaching is to a greater depth.

La Prairie soils are mostly cultivated. Corn, small grains, and alfalfa produce good to high yields, and other crops common in the area are grown.

La Prairie complex (0 to 3 percent slopes) (Lp).—This complex is about 40 percent La Prairie silt loam, about 30 percent Brookings silt loam, about 20 percent Hidewood silty clay loam, and about 10 percent Parnell silty clay loam. In this county these soils occur in the western part in swales, in narrow valleys, and in slight depressions on uplands. Because these areas are narrow and long, generally they are not cultivated separately.

Fields that are cultivated separately can be improved by seeding grasses and legumes, by fertilizing where needed, and by returning all crop residue to the surface soil. These practices improve tilth and protect the soil with cover.

The soils of this unit are described separately in this section under their respective names.

Capability unit I–2; windbreak suitability group 2.

La Prairie silt loam (0 to 3 percent slopes) (Ls).—This soil is on nearly level high flood plains or low stream terraces. Because runoff is very slow, erosion is not a problem. The hazard of flooding is very slight. This soil has a good supply of organic matter.

The profile of this soil is like the one described for the series.

Tilth can be improved and the soils protected by seeding grasses and legumes, by fertilizing where needed, and by returning all crop residue to the surface soil.

About 10 percent of the total acreage mapped as this soil is Lamoure silty clay loam.

Capability unit I–2; windbreak suitability group 2.

Luton Series

In the Luton series are deep, somewhat poorly drained, fine-textured soils that formed in water-deposited sediments on level flood plains. In this county these soils are mainly along the Big Sioux River.

The surface layer is very dark gray to black, medium acid silty clay or clay, about 7 inches thick. It is difficult to work because it puddles if it is worked when wet and it clods when it dries.

The subsoil extends from the surface layer to a depth of about 60 inches. It grades from a very dark gray or black silty clay in the upper part to dark-gray and grayish-brown silty clay loam in the lower part. In some places the lower subsoil contains strata of coarser material or a buried soil profile. The subsoil is slightly acid to neutral in the upper part and moderately alkaline in the lower part. It is difficult to dig when dry or wet.

The material below a depth of 60 inches consists of stratified clay, silt, sand, or gravel. It is moist or wet most of the time.

These somewhat poorly drained soils are very slowly permeable, and water may pond on them during wet seasons. They have good natural fertility and a high water-holding capacity.

Luton soils are not so well drained as the coarser textured La Prairie soils. The Luton soils developed in more clayey sediments than did the coarser textured Lamoure soils and are leached to a greater depth.

Most areas of the Luton soils are cultivated, but in spring farming operations may be delayed because of wetness. Good to excellent yields of corn, soybeans, and alfalfa are produced in areas protected from excess water.

Luton clay (0 to 2 percent slopes) (Lu).—This soil occurs mainly on level flood plains of the Big Sioux River, and most of it is cultivated. Runoff and permeability are slow. Flooding is frequent, and the water table fluctuates seasonally. Draining, bedding, and other practices reduce the hazard of flooding.

This soil has a profile like the one described for the series.

Lamoure silty clay loam is included in many areas mapped as Luton clay and makes up about 10 percent of the total acreage mapped.

Capability unit IIIw–11; windbreak suitability group 2.

Maddock Series

In the Maddock series are excessively drained sandy soils that are in loess or outwash materials that have been reworked by wind. These soils are gently sloping to moderately steep. In Minnehaha County they extend out from old gravelly hills of the uplands, in the northeastern part of the county. They also extend across the hilltops in a northwest-southeast direction on the eastern side of the breaks along the Big Sioux River and along Skunk Creek.

The surface layer is very dark grayish-brown to yellowish-brown, slightly acid to neutral loamy fine sand, about 6 inches thick. It has weak, fine, granular structure and is easy to work when dry or moist.

The subsoil is very dark grayish-brown to yellowish-brown, neutral loamy sand, about 14 inches thick. It has weak, prismatic or subangularly blocky structure and is very easy to work when dry or moist. Underlying the subsoil is very loose fine sand that, in most places, is limy at a depth of 40 inches.

Because these soils are eroded, the surface layer ranges from 4 to 8 inches in thickness, and from grayish brown to yellowish brown in color. The subsoil is very weakly developed. Thin layers of gravel may occur in the subsoil and in the underlying material. Lime has accumulated at a depth of 26 to 48 inches.

These excessively drained soils are low in fertility. They take in water readily but are droughty because they have a low water-holding capacity. Runoff is rapid on the steeper slopes and causes sheet and gully erosion.

The Maddock soils are coarser textured than the Egeland and the Flandreau soils and are less developed in the subsoil.

Most areas of Maddock soils are cultivated, but yields are among the lowest in the county. These soils are susceptible to wind and water erosion and need management that includes erosion control. Maintaining organic matter and adding fertilizers will help to increase yields. Corn, small grains, and alfalfa are grown, but hay or pasture is better suited to areas that have slopes of more than 5 percent.

Maddock loamy fine sand, 3 to 5 percent slopes, eroded (MdB2).—This soil occurs on gently sloping sandy uplands east of the Big Sioux River and of Skunk Creek. It takes in water rapidly and has slow runoff. Most of this soil is cultivated to crops commonly grown in the area, but yields are generally low.

The surface layer is very dark grayish-brown loamy fine sand, about 6 inches thick. It is very easy to work, but it is susceptible to wind erosion if it is not protected. The subsoil is more sandy than the surface layer and is about 14 inches thick. The underlying material is loose fine sand. Lime occurs at a depth of about 40 inches.

This soil is droughty. Wind erosion is a problem on this soil. Wind stripcropping, seeding grasses and legumes, returning all crop residue to the surface, and other practices help to maintain and increase fertility and to control erosion. Additions of nitrogen and phosphate are needed.

Included in mapped areas of this soil is Egeland loam, 3 to 5 percent slopes, which makes up about 10 percent of the total acreage.

Capability unit IVe-4; windbreak suitability group 4.

Maddock loamy fine sand, 5 to 9 percent slopes, eroded (MdC2).—This soil occurs on moderately sloping sandy uplands east of the Big Sioux River and of Skunk Creek. It is similar to Maddock loamy fine sand, 3 to 5 percent slopes, eroded, but it has a thinner surface layer, more rapid runoff, and is more droughty than that soil. Most of this soil is cultivated, but yields of common crops generally are not high enough for profitable production. Hay and pasture are the best uses.

Included in mapped areas of this soil is Egeland loam, 5 to 9 percent slopes, eroded, which make up about 8 percent of the total acreage.

Capability unit VIe-4; windbreak suitability group 4.

Maddock loamy fine sand, 9 to 17 percent slopes, eroded (MdD2).—This inextensive, moderately steep soil occurs on sandy uplands. It is on the knolls and breaks of hills east of the Big Sioux River and of Skunk Creek. It is susceptible to wind erosion and to a moderate amount of water erosion. About one-half of this soil is cultivated, and the rest is in hay or pasture, which is its best use. Erosion is moderate because this soil has been farmed up and down slopes and pasture has been overgrazed.

The surface layer is very dark grayish-brown to yellowish-brown loamy fine sand and loamy sand, about 5 inches thick. The subsoil is about 8 inches thick and has very weak, subangular blocky structure. The underlying material is loose fine sand that is limy in most places at a depth of 26 inches. On the breaks of hills, glacial till may crop out or occur in the subsoil.

Included in mapped areas of this soil are Maddock loamy fine sand, 5 to 9 percent slopes, eroded, and Buse loam. The Maddock soil makes up about 10 percent of the total acreage, and the Buse soil about 4 percent.

Capability unit VIe-4; windbreak suitability group 4.

Moody Series

Soils of the Moody series are deep, well-drained silty clay loams that formed in calcareous, wind-deposited silty material. These soils are on nearly level to sloping uplands (fig. 6) in the eastern two-thirds of the county. They are among the most extensive soils in the county.

The surface layer is a dark grayish-brown to very dark brown silty clay loam, about 7 inches thick. This layer is friable and easy to work when moist but is slightly hard when dry. It is medium acid.

The subsoil generally is very dark grayish-brown to brown silty clay loam but, in some places, is silt loam in the lower part. Its structure permits roots to penetrate easily. The subsoil is easy to work when moist but is slightly hard when dry. It is slightly acid in the upper part and is moderately alkaline in the lower part.

The parent material is wind-deposited silty material. It is easy to work when moist or dry and is moderately alkaline.

The surface layer ranges from 5 to 8 inches in thickness. The subsoil extends to a depth of 30 to 40 inches. Lime occurs in the lower part of the subsoil or in the silty parent material. One inextensive Moody soil is about 46 inches deep to rock.

Figure 6.—**Soil profile of Moody silty clay loam. Top arrow, 0 to 7 inches of surface soil; middle arrow, 6 to 11 inches of transition between surface and subsoil; bottom arrow, 11 to 30 inches of subsoil. Lime accumulation at 30 inches.**

Moody soils are well drained and fertile, but they are deficient in nitrogen and phosphorus. These soils have a good water-holding capacity. They are likely to erode if the slopes are unprotected.

The Moody soils have a thicker surface layer and subsoil than the Nora and the Crofton soils and are generally darker colored, are higher in clay content, and are leached deeper to lime than those soils. A subsoil developed in wind-deposited silt distinguishes the Moody soils from Kranzburg soils, which have a subsoil generally developed in glacial till. The Moody soils are better drained than the Trent soils.

These soils are mostly cultivated and are among the highest yielding soils in the county. Corn is the main crop, but small grains, soybeans, and alfalfa are also grown. Yields are high under careful management that provides control of runoff and erosion, cropping systems that maintain fertility, and additions of needed fertilizers.

Moody silty clay loam, 1 to 3 percent slopes (MoA).—This nearly level soil is on silty uplands in the eastern two-thirds of the county. Runoff is moderate, and erosion is not a problem except on long slopes.

The profile of this soil is like the one described for the series.

This soil is mostly cultivated and is one of the highest yielding soils in the county. Corn is the main crop, but also grown are small grains, soybeans, alfalfa, and other crops common in the area.

This soil can be protected and yields increased by seeding grasses and legumes; fertilizing with mineral fertilizers, barnyard manure, or both; and returning all crop residue to the surface soil.

About 10 percent of the total acreage mapped as this soil is Trent silty clay loam, and about 4 percent is Alcester silt loam.

Capability unit I–2; windbreak suitability group 2.

Moody silty clay loam, 3 to 5 percent slopes (MoB).—This gently sloping soil is on silty uplands in the eastern two-thirds of the county. Runoff is moderate and erosion is likely.

The profile of this soil is similar in color and texture to the one described for the series, but its surface layer and subsoil are slightly thinner. The depth to lime is more than 30 inches in most places.

Most of this soil is cropped, and under appropriate management it produces good yields of corn, small grains, and alfalfa. Other crops common in the area are also grown. The content of organic matter needs to be increased, and this increase maintained. Practices to control erosion include: Tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue.

About 10 percent of the total acreage mapped as this soil is Nora silt loam, and about 4 percent is Alcester silt loam.

Capability unit IIe–2; windbreak suitability group 2.

Moody silty clay loam, moderately shallow, 0 to 2 percent slopes (MsA).—This nearly level, well-drained soil is on uplands and is moderately shallow over quartzite. It formed in silty materials that were deposited by wind near outcrops of quartzite. The largest area is southwest of Dell Rapids.

The surface layer is dark grayish-brown to very dark brown silty clay loam, about 7 inches thick. It is easy to work but puddles if it is worked when wet. The subsoil, which extends to bedrock, is dark yellowish-brown to very dark grayish-brown silty clay loam in the upper part and is silt loam in the lower part. Lime has accumulated about 4 to 8 inches above the bedrock.

The small total acreage of this soil is mostly cultivated. Yields of corn, small grains, and alfalfa are fair. The water-holding capacity is fair, but the soil is droughty when rainfall is low. Practices needed to control erosion and conserve moisture on the smaller fields are seeding cover crops and managing crop residue. The larger areas require wind stripcropping to lessen the amount of soil that blows away.

Included in mapped areas of this soil are Moody silty clay loam, 1 to 3 percent slopes, and Alcester silt loam. These soils are included in about equal amounts and together make up about 14 percent of the total acreage. Also included are small areas that are shallow to bedrock.

Capability unit IIIs–5; windbreak suitability group 2.

Moody-Nora silty clay loams, 3 to 5 percent slopes (MNB).—This complex of gently sloping Moody and Nora soils is in silt deposited by wind. It is extensive within the eastern two-thirds of the county. Runoff is moderate and erosion is likely. The complex consists of about 60 percent Moody silty clay loam, about 30 percent Nora silt loams, and about 10 percent of Alcester silt loam, 3 to 5 percent slopes.

Profiles of a Moody soil and of a Nora soil are described in their respective series.

Much of this mapping unit is cultivated and produces good yields under good management. Practices needed to control erosion include tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue.

Capability unit IIe–2; windbreak suitability group 2.

Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded (MNB2).—This complex occurs on loessal uplands with Moody-Nora silty clay loams, 3 to 5 percent slopes, but it is not so extensive as those soils. The Moody soil occupies about 50 percent of the total acreage, the Nora soil about 40 percent, and Alcester silt loam about 10 percent. Much of this complex is cultivated, but yields are not so good as those on the uneroded complex.

The surface layer of this complex is thin, and part of it has been mixed with the subsoil. As a result of this mixing, the plow layer is yellowish brown. The depth to lime ranges from 10 to 30 inches in the Nora soil and is more than 30 inches in the Moody soil.

Profiles of a Moody soil and of a Nora soil are described in their respective series.

Erosion and runoff are the main limitations on these soils, and the content of organic matter is low. To reduce erosion and increase the supply of organic matter, use these practices: Tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue.

Capability unit IIIe–2; windbreak suitability group 2.

Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded (MNC2).—This complex occurs on eroded, sloping uplands in the eastern two-thirds of the county. It consists of about 51 percent Moody silty clay loam, about 35 percent Nora silt loam, about 10 percent Crofton silt loam, and about 4 percent Alcester silt loam. Much of this complex is cultivated, and yields are fair.

Profiles of a Moody soil and of a Nora soil are described in their respective series.

Erosion is the main hazard and is the result of somewhat excessive runoff. The entire surface layer has been removed in some places, and in most places at least half has been removed. The yellowish-brown plow layer is a mixture of surface soil and subsoil material. Lime is at a depth of 10 to 20 inches in the Nora soil and at about 30 to 36 inches in the Moody soil. Erosion can be controlled by using these practices: Tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue. The supply of organic matter can be increased by using grasses, legumes, greenmanure crops, and mineral fertilizers.

Capability unit IIIe–2; windbreak suitability group 2.

Nora Series

In the Nora series are deep, well-drained soils that developed in calcareous loess. These extensive soils occur on sloping to steep uplands in the eastern two-thirds of the county. They occur near the Moody soils in the steeper areas and near Crofton soils in less sloping areas.

The surface layer is generally very dark grayish-brown to very dark brown, mildly alkaline silt loam, about 5 inches thick. It has weak, fine, granular structure and is easy to work.

The subsoil is very dark grayish-brown and olive-brown to light olive-brown silt loam. It has very weak, prismatic structure and is easy to work. The upper part of the subsoil is moderately alkaline.

Underlying the subsoil is light yellowish-brown, strongly alkaline silt loam parent material that was deposited by the wind.

The surface layer ranges from 3 to 6 inches in thickness. Where this layer is thinner than the plow layer, it is lighter colored because it has been mixed with the subsoil. In some places on the steeper, more eroded slopes, lime occurs at a depth of 10 inches.

Nora soils are slightly coarser textured than Moody soils and have a thinner surface layer. They have better subsoil development and are shallower to lime than the Crofton soils. Lime occurs below a depth of 10 inches in the Nora soils but is above that depth in the Crofton soils.

These Nora soils are well drained and fair in natural fertility. They respond well to good management. They show a deficiency in nitrogen and phosphorus. Erosion is a hazard if runoff is not controlled, but the water-holding capacity is good. The degree of erosion depends on the steepness and length of slope, the amount of runoff, and the kind and amount of surface cover.

Most areas of these soils are cultivated. Corn, oats, small grains, and alfalfa are the main crops, but other crops common in the area are also grown. Yields are only fair, but they can be increased by adding fertilizers, and by using practices that conserve soil and water.

Nora-Crofton silt loams, 5 to 9 percent slopes, eroded (NCC2).—This complex occurs in loess on the sloping uplands of the central and southeastern parts of the county. Runoff is moderately rapid, and erosion is a problem. Generally, the area consists of about 48 percent Nora soil, about 40 percent of Crofton soil, and about 12 percent of Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded, as well as very small areas of Alcester silt loam. Most areas of these soils are cultivated. Yields of corn, small grains, and alfalfa are fair.

A profile of each of these soils is described in the description for the respective series.

Erosion is the main limitation on these soils, but the organic-matter content is low, and nitrogen and phosphorus are deficient in some areas. To control erosion and increase the supply of organic matter, use these practices: Tilling on the contour, stripcropping, terracing, grassing of waterways, and managing crop residue.

Capability unit IIIe–23; windbreak suitability group 2.

Nora-Crofton silt loams, 9 to 17 percent slopes, eroded (NCD2).—This complex occurs on moderately steep slopes of the loessal uplands in the central and southeastern parts of the county. Runoff is rapid, and erosion is a definite problem. Generally, the complex consists of about 50 percent Nora soils, about 42 percent Crofton soils, about 8 percent Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded, and small areas of Alcester silt loams.

For a description of these soils, refer to the Nora and Crofton series, to Crofton silt loam, 9 to 17 percent slopes, eroded, and to the two Alcester silt loams.

About 80 percent of the total acreage is cultivated, and the rest is in hay or pasture. Under good management, yields of corn, small grains, and alfalfa are fair. Yields of grasses are fair, but they will improve under good management. Nitrogen and phosphorus are deficient in some areas. Runoff and erosion can be controlled by tilling on the contour, contour stripcropping, grassing of waterways, terracing, and managing crop residue. The organic-matter content needs to be increased, and the increase maintained.

Capability unit IVe–22; windbreak suitability group 2.

Parnell Series

Parnell soils are deep, moderately fine textured and fine textured, and poorly drained. They formed in sediments washed from adjacent uplands. These soils are in flat, enclosed depressions in the western and southeastern parts of the county.

In some places on the surface is a mat of undecomposed twigs, leaves, and organic matter. The surface layer is about 10 inches thick and is black to dark grayish-brown silty clay loam or silty clay high in organic-matter content. This layer is friable and has a granular or fine, blocky structure. The subsoil is black to dark-gray silty clay or clay and is usually wet. It has blocky structure and is slightly acid. The underlying material consists of clayey sediment that, in many places, is underlain by clay loam glacial till.

The surface layer ranges from 7 to 20 inches in thickness. This large range in thickness is the result of recent sediment being washed from adjacent uplands and deposited in varying amounts. In some places the lower part of the subsoil is calcareous and contains gypsum.

These poorly drained soils have a good supply of organic matter. They are low and receive sediment and water from higher soils.

Parnell soils are more poorly drained and are leached deeper than the Hidewood and the Brookings soils.

Drained Parnell soils are slow to dry out, and farming on them is delayed. Parnell soils that are not drained are sometimes cultivated, but only in dry years. Parnell soils are best used for hay. If they are grazed, the soils puddle and yields are reduced. Plants grow around the edges of the depressions in many areas, but no plants grow where water stands for long periods.

Parnell silty clay loam (0 to 2 percent slopes) (Pa).—This soil occurs in flat depressions and in potholes in the western and southeastern parts of the county. The soils formed in local sediment washed from adjacent uplands. Water ponds in the depressions and damages hay crops. This soil is best used for hay because it puddles if it is

grazed when wet. If adequately drained, this soil can be farmed.

Mapped areas of this soil include Hidewood silty clay loam, Brookings silty clay loam, and small areas of Tetonka soils. The Hidewood soil makes up about 10 percent of the total area, and the Brookings soil about 4 percent. Tetonka soils are not mapped separately in Minnehaha County.

The upper part of the surface layer of Tetonka soils is dark-gray to black silty clay loam, about 9 inches thick. It is friable and strongly acid to medium acid with granular or platy structure. The lower part is very dark gray to gray silt loam, about 20 inches thick. It is friable, has platy structure, and is slightly acid. The subsoil is generally very dark gray to grayish-brown silty clay loam to silty clay and is usually wet. This layer is hard to dig. It is slightly acid.

Capability unit Vw-1; windbreak suitability group not assigned.

Rauville Series

Soils of the Rauville series formed in recent water-deposited sediments and are very poorly drained. In this county they are in depressions and swales, mainly on flood plains of the Big Sioux River and of Skunk Creek.

The surface layer is very dark gray to black silty clay or silty clay loam, about 13 inches thick. It has fine, granular structure, is high in organic-matter content, and is usually wet. The top 4 inches contains a large amount of undecomposed organic matter. It is neutral to mildly alkaline.

Underlying the surface layer is dark-gray to black clay, about 20 inches thick or more. The gray color indicates that this layer is wet. When it is dry, this layer is hard. It has a subangular blocky structure and is neutral to mildly alkaline.

Sand or gravel that may contain free water generally occurs at a depth below 40 inches.

These soils contain a large amount of organic matter. They have a high water table, are frequently flooded, and are too wet to be cultivated. The Rauville soils contain more clay than the Lamoure soils and are more poorly drained. Although they are as fine textured as the Luton and Dimmick soils, Rauville soils have a high water table and are more likely to be flooded.

Most areas of these soils are used for hay or pasture. If these soils are grazed when they are wet, they puddle and yields are decreased. Water commonly ponds on these soils, and drainage is difficult because suitable outlets are lacking.

Rauville silty clay loam (0 to 2 percent slopes) (Ra).—This soil generally is covered by water for long periods and seldom is dry. It is best used for hay, but hay cannot always be harvested. Dikes and ditches for draining and diverting water may prevent ponding and help establish better grass.

The profile of this soil is the same as that described for the Rauville series.

Capability unit Vw-11; windbreak suitability group not assigned.

Rock Land

This land type is made up of steep breaks, sides of canyons, and rock outcrops. The soils are very thin or are barren rock. The native vegetation is sparse and consists of scrub oak, native grasses, ferns, and lichens.

Rock land (2 to 90 percent slopes) (Ro).—This land type consists mainly of rock outcrops of Sioux quartzite. In the areas of Rock land are canyonlike walls similar to those in the Dells along the Big Sioux River near Dell Rapids.

The soils that occur in Rock land are in cracks or are thin layers over rocks. The soils vary in texture and range from glacial till to wind-deposited silt. Outwash gravel and stones may occur between the silt and the glacial till or above the rock. This area contains many stones and boulders. The vegetation in the area is scrub oaks, ferns, lichens, and tall, short, and medium native grasses.

Areas of Rock land owned privately are used for pasture. Parts of the Dells along the Big Sioux River and the Palisades along Split Rock Creek are State parks.

Capability unit VIIIs-1; windbreak suitability group not assigned.

Sinai Series

In the Sinai series are deep, well-drained, moderately fine textured and fine textured soils on uplands. These soils occur on broad, flat to gently sloping hilltops that lie within an old basin partly encircled by an eroded narrow band of silty glacial till. This old basin received deposits of clayey materials. When drainage improved, a soil profile developed (fig. 7).

The surface layer is very dark gray to black, slightly acid silty clay or silty clay loam, about 8 inches thick. It has granular structure. It is hard to work when dry and puddles if worked when wet. The subsoil is silty clay to silty clay loam, 24 inches thick or more. It has fine, blocky structure. It is grayish brown to olive brown in the upper part and light brownish gray to gray in the lower part. This layer is hard to work when dry or wet. It ranges from neutral in the upper part to moderately alkaline in the lower part. Lime generally occurs at about 19 inches.

In some places stratified silt and sand underlie the subsoil and are directly on firm glacial till. The depth to glacial till ranges from 26 to more than 60 inches. These well-drained soils have slow runoff on level areas. Although the intake of water is moderately slow, erosion is a problem only on the gentle slopes. Natural fertility is good, and the water-holding capacity is high. Permeability is moderately slow.

Sinai soils are more clayey than Kranzburg soils and are better drained than the Hidewood and the Parnell soils. Most areas of these soils are cultivated. Corn, small grains, and alfalfa are the main crops and produce good yields under good management. Seedbeds are difficult to prepare if the soil is dry.

Sinai silty clay, 1 to 3 percent slopes (SnA).—This nearly level soil is on uplands in the western part of the county. Runoff is slow. This soil is not extensive, but

Figure 7.—**Soil profile of Sinai silty clay. Surface layer, about 8 inches thick, underlain by subsoil, 8 to 24 inches thick. Lime is at a depth of about 19 inches.**

it is mostly cultivated. Tilth and premeability can be increased by growing legumes for green manure, returning crop residue to the surface soil, and by adding fertilizers as needed.

The profile of this soil is like the one described for the series.

In mapped areas of this soil are Hidewood silty clay loam and Kranzburg silty clay loam, 1 to 3 percent slopes, which together make up about 5 percent of the total acreage.

Capability unit IIs–1; windbreak suitability group 2.

Sinai silty clay, 3 to 5 percent slopes (SnB).—This soil is on gentle slopes in the western part of the county. It is susceptible to erosion because it is more sloping than Sinai silty clay, 1 to 3 percent slopes, and it has more runoff.

This soil has a profile somewhat similar to that of Sinai silty clay, 1 to 3 percent slopes, but it contains slightly less clay, and the surface soil and subsoil are thinner.

Most of this inextensive soil is cultivated. Use these practices to control erosion: Tilling on the contour, contour stripcropping, terracing, grassing the waterways, and managing crop residue.

Included in mapped areas of this soil is Kranzburg silty clay loam, 3 to 5 percent slopes, which makes up about 10 percent of the total acreage.

Capability unit IIIe–1; windbreak suitability group 2.

Sioux Series

Soils of the Sioux series are 0 to 10 inches deep to gravel. They developed in coarse glacial material on uplands and stream terraces. These soils range from gravelly loam to sandy loam in texture. They occur on gravelly knobs or ridges, on stream terraces, and on the steep sides of drainageways. These soils are not mapped separately in Minnehaha County. They are mapped in a complex with Buse soils.

The surface layer is brown gravelly loam that is as much as 10 inches thick over gravel (fig. 8), but it may be missing in some areas.

Sioux soils are droughty and are not suited to cultivated crops. Their best use is for pasture, but yields are among the lowest in the county.

Terrace Escarpments

This land type is made up of transitional areas between the flood plains and the higher terraces. It is generally steep and stony, and runoff is very rapid. It is not suited to cultivated crops, but some areas are suited to pasture.

Terrace escarpments (7 to 20 percent slopes) (Te).—This land type occurs on steep slopes between the flood plains along rivers and the higher benches. It usually occurs in long, narrow areas and is not extensive. Runoff is rapid. This land is used mainly for pasture. In most places it is too steep or too stony for the use of farm machinery.

The surface layer is a thin gravelly, sandy, or clayey soil. It is underlain by clayey or gravelly till that contains pockets of sand. Lime occurs at or near the surface in most places.

In areas mapped as this land are Buse-Sioux complex and Maddock loamy fine sand, which together make up about 5 percent of the total acreage.

Capability unit VIIs–6; windbreak suitability group not assigned.

Trent Series

In the Trent series are deep, moderately well drained soils (fig. 9) that formed in wind-deposited silt on level uplands. Trent soils are mainly in the northeastern part of the county. They occur with the Moody and Hidewood soils.

The surface layer is very dark gray to black, nearly neutral silty clay loam, about 8 inches thick. It is usually easy to work but will puddle if worked when wet.

The subsoil is grayish brown to olive brown and extends to a depth of 40 to 50 inches. When dry, it is hard to dig, but it is friable when moist. In most places the upper part is silty clay loam and is neutral; the lower

Figure 8.—Profile of Sioux soil. Gravel occurs at a depth of about 10 inches.

part is silt loam in some places and is moderately alkaline. Mottles in the lower part indicate wetness.

The parent material is wind-deposited silt that contains gray and brown strata in some places. The brown color indicates the presence of iron and manganese in the strata. This layer is moderately alkaline. In most places the parent material is abruptly underlain by clay loam glacial till.

These soils have high natural fertility, good water-holding capacity, and somewhat slow runoff. Because of their position, they sometimes receive run-in water from adjacent higher areas.

Trent soils are not so well drained as Moody soils, but they are better drained than Hidewood soils.

Nearly all the acreage of the Trent soils is cultivated. Corn is the main crop, but small grains, soybeans, and alfalfa are also grown. Yields are good to excellent.

Figure 9.—Profile of Trent silty clay loam. Arrow indicates the depth to which dark color extends.

Trent silty clay loam (0 to 3 percent slopes) (Tr).—This soil occurs in small areas in the eastern two-thirds of the county and in large areas in the northeastern part. Runoff is somewhat slow.

The profile of this soil is the same as that described for the Trent series.

The soil is mostly cultivated and produces yields that are among the highest in the county. In most places special mechanical structures are not needed to control erosion. Yields, however, can be increased by using grasses and legumes; by fertilizing with mineral fertilizers, barnyard manure, or both; and by returning all crop residue to the surface soil.

In areas mapped as this soil are small areas of Moody silty clay loam, 1 to 3 percent slopes, which make up about 10 percent of the total acreage.

Capability unit I–2; windbreak suitability group 2.

Trent-slickspot complex (0 to 3 percent slopes) (Ts).—This complex is in the northeastern part of the county. It consists of about 67 percent Trent silty claim loam, about 25 percent slickspots, and about 8 percent Hidewood silty clay loam. Slickspots are small areas of claypan that are exposed where the surface layer has been blown away.

The profile of the Trent soil is like that described for the Trent series.

The slickspots have a thin silt loam surface layer that grades to a dark-gray silty clay loam or silty clay subsoil. The subsoil is very hard when dry and sticky when wet. It extends to a depth of about 20 inches and is calcareous in the lower part. Mottles indicate that moisture is excessive.

Drainage on this complex is slow. Water stands for longer periods on the slightly lower slickspots than it stands on the Trent soil. Natural fertility is good on the Trent soil but is poor on the slickspots. In addition, some slickspots are unproductive because their content of salts is high. For this complex, the underlying material is grayish-brown and reddish-brown, calcareous silt loam.

This complex, particularly the slickspots, needs to be drained. Also, legumes and grasses should be seeded and all crop residue returned to the soil so that tilth and permeability are improved.

Capability unit IIs–1; windbreak suitability group 5.

Vienna Series

Soils of the Vienna series formed in glacial till and are deep, well drained, and medium textured. These inextensive soils occur on nearly level to sloping uplands in the eastern two-thirds of the county. They are along well-defined drainageways and streams.

The surface layer is generally dark grayish-brown loam or silt loam, about 8 inches thick. It is slightly hard to work when it is dry. In some places a few stones may hinder farm operations. This layer is neutral to slightly acid.

The subsoil, about 22 inches thick, is brown to dark grayish-brown clay loam that generally is more clayey and less friable than the surface layer. The upper part of subsoil is neutral, and the lower part is moderately alkaline.

The parent material is light yellowish-brown, moderately alkaline, clay loam glacial till. This layer is difficult to dig.

In some places the surface layer is covered with a thin deposit of loess, and its texture ranges from loam to silty clay loam. The subsoil ranges from 16 to 30 inches in thickness. Lime has accumulated at a depth between 14 and 28 inches. On nearly level uplands, Vienna soils have a thicker subsoil and are deeper to lime than on steeper slopes and eroded knolls and breaks. In eroded areas the surface layer is mixed with the subsoil and is lighter colored than the surface layer in uneroded areas.

Except in eroded areas, these well-drained soils have moderate natural fertility and a good water-holding capacity. Erosion is likely on the sloping soils.

The Vienna soils have a different kind of parent material than the Kranzburg and Moody soils. The Vienna soils developed in glacial till, but the Kranzburg soils developed in loess over glacial till, and the Moody soils developed completely in loess.

About 80 percent of the total acreage of Vienna soils is used for cultivated crops, and the rest is in hay and pasture. Yields of corn, small grains, and alfalfa are good under good management but are lower on steeper slopes and in eroded areas.

Vienna silt loam, 1 to 3 percent slopes (VnA).—This inextensive soil is on nearly level, glaciated uplands. Runoff is moderate. Most of the soil is cultivated, and it produces good yields under good management. Additions of nitrogen and phosphate are needed. Also needed are the use of grasses and legumes and barnyard manure and the return of all crop residue to the surface soil.

The profile of this soil is similar to the one described for the series, but the surface layer and subsoil are slightly thicker. The depth to lime is about 20 inches.

Included in mapped areas of this soil is Kranzburg silty clay loam, 1 to 3 percent slopes, which makes up about 10 percent of the acreage.

Capability unit I–2; windbreak suitability group 2.

Vienna silt loam, 3 to 5 percent slopes (VnB).—This inextensive soil occurs on gentle slopes on glaciated uplands. It has moderate runoff that may cause erosion if it is not controlled. Practices needed to control erosion are tilling on the contour, contour stripcropping, terracing, grassing of waterways, and managing crop residue. Most of this soil is cultivated. Yields are good but are slightly less than on Vienna silt loam, 1 to 3 percent slopes. Additions of nitrogen and phosphate are needed.

The profile of this soil is the same as the one described for the series.

Included in mapped areas of this soil is Kranzburg silty clay loam, 3 to 5 percent slopes, which makes up about 10 percent of the area.

Capability unit IIe–2; windbreak suitability group 2.

Vienna silt loam, 5 to 9 percent slopes (VnC)—This inextensive soil occurs on sloping, glaciated uplands. Runoff is moderate to moderately rapid and causes erosion if it is not controlled.

The profile of this soil is similar to the one described for the Vienna series, but the surface layer and subsoil are slightly thinner. The depth to lime is about 16 inches.

Most of this soil is cultivated, but some is in pasture. Yields are fair to good and depend on how well erosion is controlled and the other management is practiced. To control erosion, use these practices: Tilling on the contour, contour stripcropping, terracing, grassing of waterways, and returning crop residue to the soil. Nutrients known to be needed are nitrogen and phosphorus.

Included in mapped areas of this soil are Kranzburg silty clay loam, 3 to 5 percent slopes, and Vienna silt loam, 5 to 9 percent slopes. The Kranzburg soil makes up about 6 percent of the area, and the Vienna soil about 7 percent.

Capability unit IIIe-2; windbreak suitability group 2.

Vienna silt loam, 5 to 9 percent slopes, eroded (VnC2).—This sloping, eroded soil is in glacial till on uplands. It has a thinner surface layer than Vienna silt loam, 5 to 9 percent slopes. Because the surface layer and subsoil are mixed, the plow layer is browner than that of the uneroded soil. The depth to calcareous material is about 14 inches.

Practices needed to prevent further erosion are tilling on the contour, contour stripcropping, terracing, grassing of waterways, and returning crop residue to the surface soil. About 70 percent of this soil is cultivated; the rest is in hay or pasture. Yields on this soil are not so good as on the uneroded soil.

Included in mapped areas of this soil are Vienna silt loam, 5 to 9 percent slopes, and loamy Buse soils. The Vienna soil makes up about 10 percent of the total acreage, and the Buse soils about 4 percent.

Capability unit IVe-22; windbreak suitability group 2.

Use and Management of Soils

This section discusses the use and management of soils in Minnehaha County for crops and pasture, for trees and shrubs in windbreaks, for wildlife, and for use in roads and other structures.

Managing Soils for Crops

This subsection consists of four main parts. The first part discusses some of the management practices generally followed in the county. The second part explains the capability classification system used by the Soil Conservation Service and briefly defines the capability units used in Minnehaha County. In the third part the soils in the county are placed in capability units, and the use and management of each unit is discussed. The fourth part provides a table that lists, for each soil in the county, estimated yields under two levels of management.

General practices of soil management

The chief problems of those who use and manage the soils in Minnehaha County are (1) controlling soil erosion, (2) conserving moisture, (3) using suitable cropping systems, (4) selecting suitable crops, (5) using good methods of tillage, (6) maintaining adequate fertility, and (7) keeping the soils in good tilth. Practices that protect the soils from wind and water erosion are probably the most important, because most of the soils in the county require this protection. Many good farming practices, however, accomplish more than one purpose and can be used on most of the cropland in the county.

Farmers and others who need assistance in choosing the best practices and in planning the management of their soils can obtain help from the local representative of the Soil Conservation Service, the county agent, or a representative of the South Dakota Agricultural Experiment Station.

Structures and practices that will benefit the soils of Minnehaha County are terraces, grassed waterways, contour farming, stripcropping, using suitable cropping systems, managing crop residue, and applying fertilizers at appropriate rates.

Terraces.—These structures are used to conserve water and to help control erosion. On permeable soils that allow water to enter freely, terraces are built level so that they hold water until it soaks into the soil. On soils that take in water slowly, terraces are built with a slight grade to remove excess water and to prevent erosion. The terraces are broad and gently rounded so that ordinary farm machinery can be used on them. Because they are built on the contour, terraces serve as guidelines for contour tillage. Tilling on the contour helps to maintain the terraces and to reduce runoff and to control erosion.

Grassed waterways.—Waterways are used to carry away runoff so that it does not wash away soil. They are used in contour farming, terracing, and in other farming operations to dispose of excess water safely. Grassed waterways are shaped to slow the flow of water enough to control erosion. Waterways are seeded to perennial grasses that provide permanent cover and protection from erosion.

Contour farming.—This practice consists of plowing, planting, and tilling across the slope. Contour lines can be laid out with an engineer's level, or other convenient level. In terraced fields the top of the terrace ridge may be used as a guideline. Furrows left by cultivation are on the contour and stop, or slow, the movement of water and allow the water to soak into the soil. Thus, contour farming increases the amount of available water and reduces erosion.

Stripcropping.—In this practice different crops are grown in alternate strips to help reduce erosion by water and wind. Erosion by water can be reduced by planting the strips on the contour and by alternating strips of clean-tilled crops with strips of close-growing crops that produce a large amount of residue. Changing the kinds of crops in the strips from year to year helps to maintain favorable tilth and a good supply of plant nutrients and organic matter.

Wind erosion on sandy soils can be reduced by planting alternate strips in clean-tilled crops and close-growing crops at right angles to the direction of the damaging winds. The most benefit is obtained by using narrow strips.

Cropping systems.—Growing crops in a suitable cropping system helps to keep a supply of plant nutrients in the soil and to maintain satisfactory yields. It also helps to improve tilth and permeability, and to control weeds and diseases. Legumes and grasses included in the cropping system benefit the soil.

Crop-residue management.—Good use of crop residue provides benefits and is economical. The organic matter in plant remains is used by soil as a source of nutrients and energy. A soil that contains an abundance of organic matter is generally fertile, in good tilth, and resistant of erosion. Crop residue at or near the surface protects the soil from wind erosion and from packing rains. It also reduces crusting and sealing, increases the intake of water, and reduces evaporation by shading the soil. The residue decays more quickly if nitrogen fertilizer is applied.

Tillage.—Appropriate tillage is important because a soil may be damaged if it is tilled the wrong way, or too often, or at the wrong time. Tillage is needed to prepare a good seedbed, to kill weeds, and to improve the soil generally.

If a soil is tilled when it is too wet, its structure breaks down and a plowpan is likely to form. The plowpan restricts the growth of roots and slows the penetration of water. Consequently, much water is lost in runoff. Best results are obtained by using the right kind of tillage and tillage implements for the particular job.

Fertilizer.—The results of soil tests show that most of the soils are deficient in nitrogen and phosphorus. The amount and analysis of fertilizer needed on a field, however, should be based on the result of soil tests, the kind of crop to be grown, and the yield desired. Knowing the soil type and past treatment of a field helps to determine the fertilizer needs. The soil map can be used as a guide for taking soil samples for laboratory tests. The county agricultural agent can give detailed information regarding soil testing.

Capability groups of soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. Eight capability classes are in the broadest grouping and are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is a risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony, and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are susceptible to little or no erosion but have other limitations that confine their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-2 or IIIe-2. The numbers assigned in this county are part of a statewide system and are not consecutive within subclasses.

Soils are classified in capability classes, subclasses, and units according to the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.
- Capability unit I-2.—Deep, medium-textured and moderately fine textured, moderately permeable soils that developed in loess and in glacial till.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Capability unit IIe-2.—Deep, medium-textured and moderately fine textured, moderately permeable soils on 3 to 5 percent slopes.
  - Capability unit IIe-25.—Deep, medium-textured, moderately permeable soils that have sand or gravel below 36 inches.
- Subclass IIs. Soils that have moderate limitations of moisture capacity, salinity, or alkalinity.
  - Capability unit IIs-1.—Deep, fine textured and moderately fine textured, slowly permeable soils on 0 to 3 percent slopes.
  - Capability unit IIs-25.—Deep, medium-textured soils that have sand and gravel below 36 inches on 0 to 3 percent slopes.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
  - Capability unit IIIe-1.—Deep, fine-textured, slowly permeable soil on 5 to 9 percent slopes.
  - Capability unit IIIe-2.—Deep, medium-textured and moderately fine textured, moderately permeable soils on 3 to 9 percent slopes.
  - Capability unit IIIe-3.—Deep, moderately sandy soils with moderately rapid permeability on 3 to 9 percent slopes.

Capability unit IIIe-5.—Moderately shallow, moderately permeable soil underlain by gravel at 10 to 36 inches on 3 to 5 percent slopes.

Capability unit IIIe-23.—Medium-textured, moderately permeable soils with a thin surface layer on 3 to 9 percent slopes.

Subclass IIIs. Soils that have severe limitations of moisture capacity.

Capability unit IIIs-3.—Deep, moderately sandy soils with moderately rapid permeability on 0 to 3 percent slopes.

Capability unit IIIs-5.—Moderately shallow, medium-textured soils underlain by gravel or bedrock on 0 to 3 percent slopes.

Subclass IIIw. Soils that have several limitations because of excess water.

Capability unit IIIw-11.—Deep, fine-textured, slowly permeable soils on nearly level flood plains.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IVe-4.—Deep, rapidly permeable sandy soil on 3 to 5 percent slopes.

Capability unit IVe-22.—Medium-textured, moderately eroded, moderately permeable soils that developed in loess and glacial till on 5 to 17 percent slopes.

Subclass IVw. Soils very severely limited for cultivation by excess water.

Capability unit IVw-1.—Moderately fine textured, slowly permeable soils on high terraces and in depressions.

Capability unit IVw-11.—Moderately fine textured, slowly permeable soils on flood plains.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Subclass Vw. Soils too wet for cultivation; drainage or protection not feasible.

Capability unit Vw-1.—Frequently flooded soils on bottom land and in depressions.

Capability unit Vw-11.—Soils on bottom land that are frequently flooded or have a high water table.

Class VI. Soils that have severe limitations that make them generally unsuited to cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIe-4.—Gently sloping to steep, sandy, rapidly permeable soils.

Capability unit VIe-22.—Strongly sloping and steep, medium-textured, moderately permeable soils that formed in glacial till or loess on uplands.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIIe-22.—Steep or very steep, medium-textured, moderately permeable soil on uplands.

Subclass VIIs. Soils very severely limited by moisture capacity, stones, or other soil features.

Capability unit VIIs-6.—Moderately steep to steep soil that is generally very shallow to gravel.

Capability unit VIIs-81.—Gently sloping to steep, moderately shallow, very stony soils.

Capability unit VIIs-87.—Gently sloping to steep, shallow, very stony soils.

Class VIII. Soils and landforms having limitations that preclude their use without major reclamation, for commercial production of plants, and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIs. Rock or soil materials that have little potential for production of vegetation.

Capability unit VIIIs-1.—Rock outcrops and steep canyon walls.

Management of soils by capability units

In the following pages each capability unit is described, and the soils in it are listed. Use and management of the soils in each unit are discussed. As stated in the explanation of capability grouping, a capability unit consists of soils that are suited to the same crops, require similar management, and produce about the same yields.

In addition to the capability units, which are made up of mapping units delineated on the soil map and designated by a symbol, are 6,035 acres of marsh. This marsh is designated by the conventional sign for marsh. The areas have little agricultural use. In places they are dug out or partly dammed to provide water for livestock. They provide nesting and feeding sites for waterfowl, and nesting sites and cover for pheasant. Some areas produce muskrats, which are hunted for fur.

CAPABILITY UNIT I-2

In capability unit I-2 are deep, nearly level soils in loess on terraces, on high stream bottoms, and on uplands. These soils have a dark-colored, medium-textured and moderately fine textured surface layer that is easy to work. They absorb and store water well, and release it readily to crops. Erosion is not a problem. Yields are high if management is good. The soils are—

Alcester silt loam, 1 to 3 percent slopes.
Brookings silt loam.
Kranzburg silty clay loam, 1 to 3 percent slopes.
Kranzburg-Beadle silty clay loams, 1 to 3 percent slopes.
La Prairie complex.
La Prairie silt loam.
Moody silty clay loam, 1 to 3 percent slopes.
Trent silty clay loam.
Vienna silt loam, 1 to 3 percent slopes.

In the La Prairie complex are small areas of somewhat poorly drained to poorly drained soils that are too small to be mapped separately. If, however, they were larger and were mapped, they would be placed in a lower capability class than class I.

The soils in capability unit I–2 generally do not need mechanical structures to protect them. Beneficial management includes seeding of grasses and legumes; adding mineral fertilizers, barnyard manure, or both; and returning all crop residue to the surface soil. Corn (fig. 10) and other row crops producing large supplies of residue can be grown continuously on these soils if large amounts of fertilizers are added and all crop residue is returned to the soil. Crops suited to these soils are small grains, corn, soybeans, flax, sorghum, bromegrass, sweetclover, and alfalfa.

Figure 10.—Corn on Trent silty clay loam. Capability unit I–2.

CAPABILITY UNIT IIe–2

Soils in capability unit IIe–2 are gently sloping, deep, and moderately permeable. Yields are good if these soils are managed well. These soils are similar to those in capability unit I–2 but are more likely to erode. The soils in capability unit IIe–2 are—

Alcester silt loam, 3 to 5 percent slopes.
Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes.
Kranzburg silty clay loam, 3 to 5 percent slopes.
Moody silty clay loam, 3 to 5 percent slopes.
Moody-Nora silty clay loams, 3 to 5 percent slopes.
Vienna silt loam, 3 to 5 percent slopes.

Sheet and gully erosion are the main limitations on these soils. Also, the organic matter needs to be increased, and that increase maintained. Practices needed to control erosion are: Tilling on the contour, contour stripcropping (fig. 11), terracing, grassing of waterways, managing crop residue, and fertilizing. Green-manure crops improve tilth. Crops suited to these soils are corn (fig. 12), sorghum, soybeans, small grains, flax, grasses, and legumes.

CAPABILITY UNIT IIe–25

In capability unit IIe–25 are gently sloping, medium-textured soils that are underlain by gravel or sand below 36 inches. They occur with the soils in capability unit IIs–25 on terraces and uplands. Yields are fair to good. The soils are—

Estelline silt loam, 3 to 4 percent slopes.
Flandreau loam, 3 to 5 percent slopes.

The main limitations of these soils are the hazard of erosion and their droughtiness. The droughtiness is caused by the low rainfall and the underlying gravel and sand. Organic matter needs to be increased and maintained. Practices required to control erosion are tilling on the contour, contour stripcropping, terracing, grassing of waterways, managing crop residue, and fertilizing.

The occasional use of green-manure crops and close-growing crops such as grasses and legumes helps to control erosion. Crops suited to these soils are corn, sorghum, soybeans, small grains, flax, grasses, and legumes.

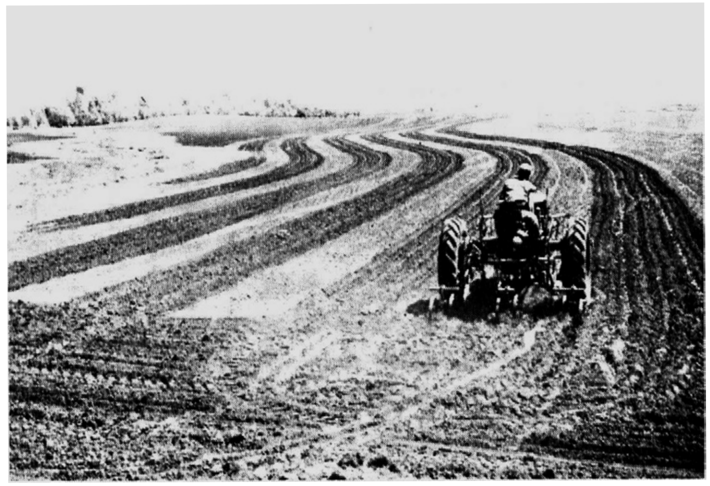

Figure 11.—Moody silty clay loam, 3 to 5 percent slopes. First cultivation of corn on the contour. Capability unit IIe–2.

CAPABILITY UNIT IIs–1

In capability unit IIs–1 are nearly level, well drained and moderately well drained, moderately fine textured

Figure 12.—Moody silty clay loam, 3 to 5 percent slopes. Corn on the contour; bromegrass and alfalfa in waterway. Capability unit IIe–2.

and fine textured soils on terraces and uplands. Because they are clayey or have imperfect drainage, these soils take in water slowly and dry out slowly in the spring. Planting may be delayed, but yields are good if the soils are managed well. An exception is the slickspots where few or no crops are grown. The soils are—

Benclare silty clay loam.
Corson silty clay, 1 to 3 percent slopes.
Sinai silty clay, 1 to 3 percent slopes.
Trent-slickspot complex.

Trent soil mapped as a single soil is in capability unit I–2. In the complex, however, the Trent soil is so intermingled with slickspots that it cannot be separated. If the Trent soil and slickspots were each large enough to be mapped as a separate unit, the Trent soil would be in a higher class than II and the slickspots would be in a lower class.

The main limitation of these soils is the slow permeability. In some places surface drainage is needed. To improve tilth and permeability of these soils, grow legumes for green manure, return all crop residue to the surface soil, and add organic and inorganic fertilizers. Crops suited to these soils are corn, sorghum, soybeans, small grains, flax, grasses, and legumes.

CAPABILITY UNIT IIs–25

Capability unit IIs–25 consists of nearly level, medium-textured soils that are underlain by gravel or sand below 36 inches. These soils occur on stream terraces and on uplands. Yields are good if management is good. The soils are—

Athelwold silt loam.
Estelline silt loam, 0 to 2 percent slopes.
Flandreau loam, 1 to 3 percent slopes.

These soils are somewhat droughty if rainfall is low. Because the Athelwold soils are in swales, they receive run-in water and can withstand drought better than the other soils in this group. Droughtiness can be lessened by using grasses, legumes, and crop residue to maintain a high organic-matter content. Crops suited to these soils are sorghum, soybeans, small grains, flax, and grasses. Corn, alfalfa, and other deep-rooted crops are not so well suited, because of the underlying gravel or sand.

CAPABILITY UNIT IIIe–1

The soils in capability unit IIIe–1 are gently sloping, deep, and fine textured and moderately fine textured. Because these gently sloping soils are likely to erode, they need mechanical structures. Yields are good if these soils are managed well. The soils are—

Corson silty clay, 3 to 5 percent slopes, eroded.
Corson silty clay, 5 to 9 percent slopes, eroded.
Sinai silty clay, 3 to 5 percent slopes.

The main limitations of these soils are the hazard of erosion and the slow permeability caused by the clayey surface layer and subsoil. Practices needed to control erosion are tilling on the contour, contour stripcropping, terracing, grassing of waterways, managing crop residue, and fertilizing. Tilth is improved if a green-manure crop is seeded after the corn is harvested and several days before the soil freezes. Crops suited to these soils are small grains, corn, soybeans, flax, sorghum, bromegrass, sweetclover, and alfalfa.

CAPABILITY UNIT IIIe–2

In capability unit IIIe–2 are deep, medium-textured and and moderately fine textured soils that are more sloping or more eroded than the soils in capability unit IIe–2. The soils in capability unit IIIe–2 formed from glacial till or loess. They are easy to work and produce good yields if management is good. These soils have moderate to high water-supplying capacity and are permeable to roots to a depth of several feet. They are—

Flandreau loam, 3 to 5 percent slopes, eroded.
Flandreau loam, 5 to 9 percent slopes, eroded.
Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes.
Kranzburg silty clay loam, 5 to 9 percent slopes, eroded.
Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded.
Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded.
Vienna silt loam, 5 to 9 percent slopes.

Sheet and gully erosion is the main limitation on these soils. Practices needed to control runoff and to reduce erosion are tilling on the contour, contour stripcropping, terracing (fig. 13), grassing of waterways, managing crop residue, and fertilizing.

Crops suited to these soils are small grains, corn, soybeans, flax, sorghum, bromegrass, sweetclover, and alfalfa. The use of grasses and legumes and the return of crop residue to the surface soil will protect these soils and improve their tilth.

CAPABILITY UNIT IIIe–3

Capability unit IIIe–3 consists of gently sloping to moderately sloping, moderately permeable soils on uplands. These soils have a loamy surface layer and a sandy subsoil. They have moderate natural fertility and a low water-holding capacity, and they are easy to work. Although yields are low, the response to management is good. The soils are—

Egeland loam, 3 to 5 percent slopes.
Egeland loam, 5 to 9 percent slopes, eroded.

The main limitations of these soils are the hazard of erosion and droughtiness. If they are not protected, these soils blow in dry periods. Conservation practices needed to control erosion are tilling on the con-

Figure 13.—Newly built terraces to control erosion. Capability unit IIIe–2.

tour, contour stripcropping, terracing, and managing crop residue. Also, organic matter needs to be increased and the increase maintained.

A cover crop will protect this soil during the nongrowing season if it is interseeded between rows of corn and is allowed to grow after the corn is cut for silage. Crops suited to these soils are sorghum, soybeans, small grains, flax, and grasses. Corn and deep-rooted legumes are also suited to soils that are deep enough over the sandy subsoil.

CAPABILITY UNIT IIIe-5

Fordville loam, 3 to 5 percent slopes, is the only soil in capability unit IIIe-5. This gently sloping soil is underlain by gravel at a depth of 10 to 36 inches. It occurs with the soils in capability unit IIIs-5, mainly on terraces and in more sloping areas. This soil is easy to work and is moderately permeable to roots down to the gravel. Although the water-holding capacity is fair, this soil is somewhat droughty, even in short dry periods, and yields are reduced.

The main limitations of this soil are the hazard of erosion and droughtiness. The droughtiness is caused by the underlying gravel and by the thinness of the layers above it. Tilling on the contour, contour stripcropping, managing crop residue, and terracing reduce erosion.

Because this soil is shallow and its capacity to store moisture is low, small grains and grasses are better suited than is corn or deep-rooted legumes. The grasses, however, require fertilizer. In places where the soil is deep enough, terraces may be built. Crops suited to this soil are sorghum, soybeans, small grains, flax, grasses, and shallow-rooted legumes.

CAPABILITY UNIT IIIe-23

In capability unit IIIe-23 are deep, medium-textured soils that formed in glacial till or loess. These soils are easy to work. Although yields are only fair, they can be increased by good management. These soils are moderately permeable and have a good water-supplying capacity. They are easily penetrated by roots to a depth of several feet. The soils are—

Kranzburg-Buse loams, 3 to 5 percent slopes.
Nora-Crofton silt loams, 5 to 9 percent slopes, eroded.

Included with some of these soils are small knobs that are not so well suited to crops as the soils in which they occur.

The main limitations of the soils in this group are the hazard of erosion and the thin surface layer. Also, there is a continual need to increase organic matter. Erosion can be reduced by contour tillage or contour stripcropping supported by terraces. The terrace outlets should be grassed to prevent gullying. Managing crop residue is also beneficial in controlling erosion and in adding organic matter to the soils.

Crops suited to these soils are small grains, corn, flax, sorghum, bromegrass, sweetclover, and alfalfa. Although soybeans can be grown, cultivation of that crop is likely to encourage erosion unless the soybeans are planted on the contour. The row crop should be one that produces a large amount of residue, and this residue should be returned to the soils. Frequent use of grasses and legumes reduces erosion and improves tilth.

CAPABILITY UNIT IIIs-3

In capability unit IIIs-3 are deep, nearly level to gently sloping, rapidly permeable, moderately sandy soils on hummocky high bottoms, on stream terraces, and on uplands. These soils developed in materials that were deposited by water and, in some places, have been reworked by wind. Yields generally are low, but in swales and depressions they are good. The soils are—

Egeland loam, 1 to 3 percent slopes.
Hecla-Hamar complex.

The main limitations of these soils are droughtiness and the hazard of wind erosion. The Hecla soil is likely to blow, but the Hamar soil is in lower areas where erosion is not a hazard. Management needed to prevent erosion is wind stripcropping and managing crop residue.

Interseeding a cover crop between the rows of corn or sorghum helps to control erosion, especially if the row crops are to be cut for silage. The use of grasses and legumes, and the return of crop residue to the surface soil, also help to control erosion. Crops best suited to this soil are corn, sorghum, small grains, grasses, and legumes.

CAPABILITY UNIT IIIs-5

Capability unit IIIs-5 consists of moderately shallow, medium-textured soils that are underlain at a depth of 10 to 36 inches by gravel or by bedrock. These soils occur on stream terraces and on uplands. They are easy to work and are permeable to roots down to the gravel or to bedrock. Because their water-holding capacity is low to fair, a slight delay in rain reduces yields. The soils are—

Fordville loam, 1 to 3 percent slopes.
Moody silty clay loam, moderately shallow, 0 to 2 percent slopes.

The main limitation of these soils is droughtiness, which is caused by the underlying gravel or bedrock and the thinness of the layer above it. Because they have a low water-holding capacity, these soils are likely to blow. Management to control erosion includes wind stripcropping, growing cover crops, and managing crop residue.

Small grains are better suited to these soils than row crops. If mineral fertilizers are added, grass alone can be used. Crops suited to these soils are sorghum, soybeans, small grains, flax, grasses, and shallow-rooted legumes. When rainfall is less than normal, alfalfa yields are low.

CAPABILITY UNIT IIIw-11

Luton clay is the only soil in capability unit IIIw-11. This deep, fine-textured, slowly permeable soil is flooded occasionally, or it has a fluctuating water table. It occurs on broad flood plains. Yields are good if rainfall is normal or even less than normal, and they can be increased by good management.

The main limitations of this soil are flooding, a fluctuating water table, and slow permeability. Drainage and bedding may be required to reduce the hazard of flooding. When floods are late in spring and corn cannot be planted, catch crops such as sudangrass, millet, or soybeans can be substituted for corn. Alfalfa or green-manure crops help to improve tilth and permeability. Other crops suited to this soil are flax, sorghum, grasses, and alsike clover. This soil can be farmed separately from other soils.

CAPABILITY UNIT IVe-4

The only soil in capability unit IVe-4 is Maddock loamy fine sand, 3 to 5 percent slopes, eroded. This sandy soil occurs on uplands and is rapidly permeable and excessively drained. It developed on hilltops in loess or on plains in outwash material that has been reworked by wind.

The surface layer is loamy fine sand, about 5 inches thick. The subsoil is loamy sand, about 14 inches thick, and is lighter colored than the surface layer. This eroded soil is susceptible to further erosion if it is not protected by close-growing plants. Although water is absorbed rapidly, the water-holding capacity is low. Natural fertility is normally low.

The main limitations of this soil are droughtiness and the hazard of wind and water erosion. Erosion can be controlled and fertility maintained by tilling on the contour, contour stripcropping, wind stripcropping, grassing of waterways, fertilizing, and managing crop residue.

The cropping system should provide grass or other close-growing crops most of the time. Because this soil is sandy and does not store much moisture, crops that take a long time to mature are not well suited. Suitable crops are small grains, sorghum, sweetclover, and alfalfa.

CAPABILITY UNIT IVe-22

Capability unit IVe-22 consists of deep, medium-textured, moderately permeable soils that formed in glacial till on rolling uplands and on valley slopes. These moderately eroded soils have a thin surface layer and are subject to further erosion. They have lost some of their original fertility. Although yields are fair, they can be increased by good management. The soils are—

Buse-Kranzburg loams, 5 to 9 percent slopes, eroded.
Buse-Kranzburg loams, 9 to 17 percent slopes, eroded.
Buse-Vienna loams, 5 to 9 percent slopes, eroded.
Crofton silt loam, 5 to 9 percent slopes, eroded.
Crofton silt loam, 9 to 17 percent slopes, eroded.
Nora-Crofton silt loams, 9 to 17 percent slopes, eroded.
Vienna silt loam, 5 to 9 percent slopes, eroded.

Sheet and gully erosion is the main limitation on these soils. This erosion can be controlled by tilling on the contour, contour stripcropping, grassing of waterways, terracing, and managing crop residue. Additions of fertilizer are also needed. These soils should be kept in grasses, legumes, or close-growing crops most of the time, but an occasional row crop may be grown. The crops best suited to these soils are corn, sorghum, small grains, flax, alfalfa, sweetclover, and bromegrass.

CAPABILITY UNIT IVw-1

In capability unit IVw-1 are deep, somewhat poorly drained to poorly drained, moderately fine textured soils that occur on high terraces and in slight depressions, draws, and swales of the uplands. These soils are somewhat difficult to work. They are high in natural fertility and have a high water-supplying capacity. Because of their low position, these soils are flooded frequently and crops are sometimes destroyed. The soils are—

Benclare silty clay loam, poorly drained.
Hidewood silty clay loam.
Hidewood silty clay loam, calcareous.

The main limitations of these soils are frequent flooding and slow permeability. The flooding hazard can be reduced by drainage, bedding, and other practices. If flooding occurs so late in spring that corn cannot be planted, catch crops such as sudangrass, millet, or soybeans can be substituted for the corn. These soils are well suited to reed canarygrass.

CAPABILITY UNIT IVw-11

Lamoure silty clay loam is the only soil in capability unit IVw-11. This soil occurs on flood plains and is moderately fine textured, slowly permeable, and somewhat poorly drained to poorly drained. It has a fluctuating water table and is frequently flooded. The supply of organic matter is good. If flooding is prevented and the water table is lowered, yields of corn or small grains are excellent.

The main limitations of this soil are the flooding hazard and the fluctuating water table. The water intake is somewhat slow, and the soil is slow to dry in spring. To reduce damage by flooding, this soil can be drained by open ditches and by tile lines, or it can be protected by bedding or diversion ditches. If wetness delays the planting of corn or oats, catch crops such as sudangrass, millet, or soybeans can be substituted for the corn or oats. These soils are well suited to reed canarygrass.

CAPABILITY UNIT Vw-1

In capability unit Vw-1 are deep, medium-textured soils that are flooded frequently. These soils occur on bottom land and in depressions of the uplands. They are—

Alluvial land.
Parnell silty clay loam.

Because of frequent flooding, these soils are not suited to cultivated crops. Bromegrass and similar grasses can be grown, and they help control erosion. The Parnell soil is suited to reed canarygrass and other grasses that can be used for pasture or hay. Hay is a better use than pasture, because trampling of the soil by animals causes puddling.

CAPABILITY UNIT Vw-11

Capability unit Vw-11 consists of deep, nearly level, moderately fine textured and fine textured soils on flood plains. These soils are flooded frequently, or they have a high water table that limits their use to special plants. The soils are—

Dimmick clay.
Rauville silty clay loam.

The main limitation of these soils is wetness. Some fields can be improved by digging drainage ditches, by tiling, or by building dikes. Then, the fields could be seeded to reed canarygrass and alsike clover for hay and pasture. Yields of hay would be high, but grazing during wet periods would cause puddling.

CAPABILITY UNIT VIe-4

Capability unit VIe-4 consists of deep, gently sloping to steep, excessively drained, sandy soils on uplands. These soils occur in outwash sands reworked by wind. They take in water readily, but heavy rainfall causes runoff and erosion. These soils have a low water-hold-

ing capacity and are very droughty. They are low in natural fertility. The soils are—

Maddock loamy fine sand, 5 to 9 percent slopes, eroded.
Maddock loamy fine sand, 9 to 17 percent slopes, eroded.

The main limitations of these soils are droughtiness and the hazard of wind and water erosion. Consequently, the best use for these soils is hay or pasture. Cultivated fields ought to be seeded to a mixture of native grasses and legumes. Seeding in the stubble of old crops helps to protect the soil and the seedlings. To obtain good stands and high yields, add fertilizer as needed.

Pasture should not be overstocked. Grazing should be rotated and deferred to allow grasses to make seed. Weeds and brush should be controlled. When the pasture is in top condition, the dominant native grasses are bearded wheatgrass, big bluestem, switchgrass, porcupinegrass, and Indiangrass.

CAPABILITY UNIT VIe–22

Capability unit VIe–22 consists of strongly sloping to steep, medium-textured, moderately permeable, and excessively drained soils on uplands. They formed in loess or glacial till. The surface layer is too thin and slopes too steep for cultivated crops. The content of organic matter and natural fertility are low. The soils are—

Buse loam, 9 to 17 percent slopes.
Crofton silt loam, 17 to 30 percent slopes.

Erosion is the main hazard. Although these soils are poorly suited to cultivated crops, they are well suited to bromegrass and alfalfa on the less steep slopes. A mixture of native grasses ought to be seeded on the steeper slopes. Seeding in stubble helps to control erosion and to keep grass seed from washing away. Good pasture management is needed to get maximum grazing. Some areas may be too steep for the use of haying machinery. These soils can produce food and cover for wildlife. Native grasses that are dominant on soils in top range condition are Indiangrass, little bluestem, big bluestem, switchgrass, green needlegrass, bearded wheatgrass, and porcupinegrass.

CAPABILITY UNIT VIIe–22

Buse soils, steep, are the only soils in capability unit VIIe–22. These soils are excessively drained and occur in glacial till on steep or very steep uplands. They are medium textured and moderately permeable. A few pebbles, stones, and boulders are scattered over the surface and through the profile. The surface layer is thin, and the supply of organic matter and the natural fertility are low.

Sheet and gully erosion are the main limitations on use of these soils. Pasture is the best use, but good management is needed to control erosion. In fields that are cultivated, a mixture of native grasses ought to be seeded in the stubble of old crops. Gullying can be prevented by shaping and sodding waterways and building mechanical structures. Dams on good sites provide water for livestock and for recreation. When the pasture is in top condition, the dominant native grasses are bearded wheatgrass, little bluestem, big bluestem, switchgrass, porcupinegrass, green needlegrass, and Indiangrass.

CAPABILITY UNIT VIIs–6

The only mapping unit in capability unit VIIs–6 is Terrace escarpments. This moderately steep to steep land type is on the breaks between stream terraces and flood plains. Its soil material is shallow to very shallow over gravelly or clayey till.

Terrace escarpments are too shallow and droughty for cultivated crops. Their best use is for pasture, but careful management is needed to control erosion. This management should provide appropriate stocking, and grazing that is rotated and deferred so that the grasses can reseed. Weeds and brush should be controlled. When the pasture is in top condition, the dominant grasses are bearded wheatgrass, little bluestem, big bluestem, switchgrass, porcupinegrass, green needlegrass, and Indiangrass.

CAPABILITY UNIT VIIs–81

Capability unit VIIs–81 consists of gently sloping to steep, very stony soils on uplands. These soils occur on flood plains of rivers and small streams. They are—

Alluvial land, rocky.
Buse-Kranzburg stony loams.
Buse stony loam, 5 to 17 percent slopes.

The main limitation of these soils is caused by stones and boulders that prevent the use of farm machinery. An additional hazard is erosion. Pasture is the best use, but careful management is needed to prevent overstocking or overgrazing and thus to increase the native grasses. Rotate and defer grazing to allow grasses to reseed. When the pasture is in top condition, the dominant native grasses are bearded wheatgrass, little bluestem, big bluestem, switchgrass, porcupinegrass, green needlegrass, and Indiangrass.

CAPABILITY UNIT VIIs–87

Buse-Sioux complex is the only mapping unit in capability unit VIIs–87. It consists of very stony soils and soils shallow to gravel. These soils occur on steep side slopes of valleys, on hills surrounding depressions, and in morainic areas.

The main limitation of these soils is caused by stones and boulders that prevent the use of farm machinery. Also, the soils are steep and susceptible to erosion. Some areas are droughty. Pasture is the best use for these soils, but it should not be overstocked or overgrazed. The grazing should be rotated and deferred so that the grasses can reseed. When the pasture is in top condition, the dominant native grasses are big bluestem, Indiangrass, little bluestem, switchgrass, porcupinegrass, and bearded wheatgrass.

CAPABILITY UNIT VIIIs–1

Rock land is the only mapping unit in capability unit VIIIs–1. It consists of the steep canyon walls and rock outcrops along streams. Any soil material that occurs is shallow and suitable only for grass and trees. The areas that are privately owned are in pasture or are idle. The State-owned areas are used for recreation.

A good stand of native grasses can be maintained in some areas if grazing is regulated. Some privately owned areas could be developed for fishing, for hunting, or for other recreational uses.

Estimated yields

Table 2 lists estimated average acre yields of corn, oats, barley, soybeans, and alfalfa that can be expected on each soil in Minnehaha County under two levels of management, which are defined in this subsection. On the same soil, however, yields vary from field to field according to past management.

Many farmers know their soils and how they respond to different systems of management. These farmers can learn from table 2 the probable yields of different crops under ordinary management and under a high level of management. The predicted yields in table 2 can also guide farmers who do not know the soils on their farms but are interested in increasing yields by improving management.

In columns A are yields to be expected under average management, or management commonly practiced in the county. Under average management, a row crop is generally grown in a sequence with a small grain, but the row crop is grown for a longer time than the small grain. Legumes and grasses are seldom used except as part of a long sequence in which the soil is in a grass-legume mixture for approximately 4 out of 20 years. Grain stubble or other crop residue is plowed under, but green-manure crops seldom are used. Commercial fertilizers generally are not added, or they are added only in small amounts to fields in row crops. Barnyard manure is applied if it is available. Contour farming, terracing, or similar conservation practices are not used.

In columns B are yields to be expected under the most intensive management that is practical. Appropriate crop sequences are used to maintain soil fertility and to assist in protecting the soil from erosion. All farm operations are timely. Clean, high-quality seed of disease-resistant, adapted varieties are used. All crop residue is returned to the soil. Green-manure crops are seeded, and barnyard manure is applied. As indicated by the results of laboratory soil tests and field trials, the most economical amount and kind of commercial fertilizers are applied. Weeds are controlled effectively.

In using table 2, these facts should be kept in mind—

1. Yields listed are estimates rather than proven results.
2. Except for grains and alfalfa on soils in class I, yields listed are averages for a long period that does not include extended periods of drought. Yields of grains and alfalfa on soils in class I are averages for one period from 1951 through 1956.
3. Considered in estimating the yields of corn was the large increase, especially in the past 7 years, that resulted from the use of hybrids.
4. Past use and management of the soils affect yields under the average level of management and affect the immediate response of soils under a high level of management.
5. The change of farming methods and the development of new crop varieties may affect future yields.

The estimates in table 2 were made for normal growing conditions. Some abnormal conditions that were not considered are (1) extreme variations in temperature, (2) variation in the amount and distribution of rainfall, (3) damaging wind or hailstorms, (4) late or early frosts, and (5) the presence of harmful insects or diseases during the growing season. Since growing conditions were considered the same for all soils, inherent soil differences and the level of management are reflected in the estimates of yields in table 2. For example, under normal conditions a somewhat poorly drained soil produces lower yields than a well-drained soil if characteristics other than drainage are the same for the two soils. Sandiness, underlying gravel, slopes, and other soil characteristics were considered in estimating yields.

TABLE 2.—*Estimated average acre yields of principal crops under two levels of management*

[Columns A list yields to be expected under average management and columns B list yields to be expected under intensive management Dashes indicate that the crop is not suitable for the soil or ordinarily is not grown on it]

Soil	Corn		Oats		Barley		Soybeans		Alfalfa	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Alcester silt loam, 1 to 3 percent slopes [1]	53	71	48	68	30	46	20	27	2. 8	3. 6
Alcester silt loam, 3 to 5 percent slopes	47	65	44	62	28	44	18	23	2. 4	3. 2
Alluvial land	--	--	--	--	--	--	--	--	--	--
Alluvial land, rocky	--	--	--	--	--	--	--	--	--	--
Athelwold silt loam	49	60	46	62	29	44	18	23	2. 3	3. 1
Benclare silty clay loam	47	65	42	60	32	45	19	24	2. 5	3. 3
Benclare silty clay loam, poorly drained	42	52	39	49	25	34	15	20	1. 1	1. 8
Brookings silt loam [1]	59	70	47	71	32	48	20	27	2. 8	3. 6
Buse-Kranzburg loams, 5 to 9 percent slopes, eroded	35	48	33	49	22	31	10	14	1. 5	1. 9
Buse-Kranzburg loams, 9 to 17 percent slopes, eroded	29	42	22	31	12	16	7	10	1. 2	1. 8
Buse-Kranzburg stony loams	--	--	--	--	--	--	--	--	--	--
Buse loam, 9 to 17 percent slopes	--	--	--	--	--	--	--	--	1. 3	1. 7
Buse soils, steep	--	--	--	--	--	--	--	--	--	--
Buse stony loam, 5 to 17 percent slopes	--	--	--	--	--	--	--	--	--	--
Buse-Sioux complex	--	--	--	--	--	--	--	--	--	--
Buse-Vienna loams, 5 to 9 percent slopes, eroded	29	42	24	33	15	18	9	13	1. 4	1. 8

See footnote at end of table.

TABLE 2.—*Estimated average acre yields of principal crops under two levels of management*—Continued

[Columns A list yields to be expected under average management and columns B list yields to be expected under intensive management. Dashes indicate that the crop is not suitable for the soil or ordinarily is not grown on it]—Continued

Soil	Corn		Oats		Barley		Soybeans		Alfalfa	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Corson silty clay, 1 to 3 percent slopes	44	62	41	56	30	43	18	23	2. 4	3. 2
Corson silty clay, 3 to 5 percent slopes, eroded	42	55	38	55	27	40	15	18	2. 2	3. 0
Corson silty clay, 5 to 9 percent slopes, eroded	37	52	36	53	24	37	12	17	1. 9	2. 7
Crofton silt loam, 5 to 9 percent slopes, eroded	36	49	34	50	23	32	10	14	1. 5	2. 1
Crofton silt loam, 9 to 17 percent slopes, eroded	33	46	23	31	15	20	8	11	1. 3	1. 9
Crofton silt loam, 17 to 30 percent slopes	------	------	------	------	------	------	------	------	1. 0	1. 7
Dimmick clay	------	------	------	------	------	------	------	------	------	------
Egeland loam, 1 to 3 percent slopes	34	48	30	45	20	30	10	15	1. 5	2. 1
Egeland loam, 3 to 5 percent slopes	31	46	29	44	18	28	9	14	1. 4	2. 0
Egeland loam, 5 to 9 percent slopes, eroded	29	44	28	43	16	26	8	13	1. 2	1. 8
Estelline silt loam, 0 to 2 percent slopes	48	58	44	60	26	40	17	22	2. 2	3. 0
Estelline silt loam, 3 to 4 percent slopes	46	56	42	54	24	38	16	21	2. 1	2. 9
Flandreau loam, 1 to 3 percent slopes	50	63	47	65	28	44	18	24	2. 7	3. 5
Flandreau loam, 3 to 5 percent slopes	45	58	42	60	26	41	17	22	2. 4	3. 2
Flandreau loam, 3 to 5 percent slopes, eroded	43	56	40	58	24	38	16	21	2. 2	3. 0
Flandreau loam, 5 to 9 percent slopes, eroded	42	55	39	57	23	37	15	20	2. 0	2. 8
Hecla-Hamar complex	34	48	31	49	22	31	12	17	1. 8	2. 4
Hidewood silty clay loam	42	52	39	49	22	32	12	17	1. 1	1. 8
Hidewood silty clay loam, calcareous	42	52	39	49	22	32	12	17	1. 1	1. 8
Kranzburg-Beadle silty clay loams, 1 to 3 percent slopes [1]	50	67	46	65	30	46	18	25	2. 7	3. 5
Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes	46	61	42	64	26	41	15	18	2. 2	3. 0
Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes	40	54	41	61	24	38	13	18	1. 8	2. 6
Kranzburg-Buse loams, 3 to 5 percent slopes	38	52	34	53	22	36	10	15	1. 5	2. 1
Kranzburg silty clay loam, 1 to 3 percent slopes	52	70	46	66	30	46	20	27	2. 7	3. 5
Kranzburg silty clay loam, 3 to 5 percent slopes	48	64	44	63	28	44	18	23	2. 4	3. 2
Kranzburg silty clay loam, 5 to 9 percent slopes, eroded	43	55	39	59	26	41	15	20	1. 9	2. 7
Lamoure silty clay loam	45	52	35	48	22	32	12	17	1. 1	1. 8
La Prairie complex [1]	50	63	38	53	28	38	16	21	1. 8	2. 3
La Prairie silt loam [1]	53	71	48	68	30	46	20	27	2. 8	3. 6
Luton clay	52	65	40	55	30	40	18	23	1. 9	2. 8
Maddock loamy fine sand, 3 to 5 percent slopes, eroded	25	40	20	30	12	19	8	11	1. 0	1. 9
Maddock loamy fine sand, 5 to 9 percent slopes, eroded	------	------	------	------	------	------	------	------	. 9	1. 8
Maddock loamy fine sand, 9 to 17 percent slopes, eroded	------	------	------	------	------	------	------	------	. 8	1. 5
Moody-Nora silty clay loams, 3 to 5 percent slopes	48	59	42	64	28	43	16	19	2. 2	3. 0
Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded	46	58	40	62	26	41	14	17	2. 0	2. 8
Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded	44	57	38	60	24	39	13	18	1. 8	2. 6
Moody silty clay loam, 1 to 3 percent slopes [1]	53	71	48	68	30	46	20	27	2. 8	3. 6
Moody silty clay loam, 3 to 5 percent slopes	49	65	44	66	30	44	18	23	2. 4	3. 2
Moody silty clay loam, moderately shallow, 0 to 2 percent slopes	40	50	37	46	26	36	15	20	1. 6	2. 2
Nora-Crofton silt loams, 5 to 9 percent slopes, eroded	42	55	36	58	23	37	12	17	1. 8	2. 6
Nora-Crofton silt loams, 9 to 17 percent slopes, eroded	35	45	24	32	16	22	11	13	1. 4	2. 0
Parnell silty clay loam	------	------	------	------	------	------	------	------	------	------
Rauville silty clay loam	------	------	------	------	------	------	------	------	------	------
Rock land	------	------	------	------	------	------	------	------	------	------
Sinai silty clay, 1 to 3 percent slopes	45	63	41	56	30	43	18	23	2. 4	3. 2
Sinai silty clay, 3 to 5 percent slopes	42	55	38	55	27	40	15	18	2. 2	3. 0
Terrace escarpments	------	------	------	------	------	------	------	------	------	------
Trent silty clay loam [1]	60	71	48	72	32	48	20	28	2. 8	3. 6
Trent-slickspot complex	40	52	38	54	26	38	12	17	2. 0	2. 8
Vienna silt loam, 1 to 3 percent slopes [1]	48	62	45	63	28	44	17	22	2. 6	3. 4
Vienna silt loam, 3 to 5 percent slopes	43	54	41	60	25	40	16	21	2. 1	2. 9
Vienna silt loam, 5 to 9 percent slopes	39	52	37	58	23	38	12	17	1. 7	2. 5
Vienna silt loam, 5 to 9 percent slopes, eroded	36	49	34	56	22	36	11	16	1. 6	2. 4
Fordville loam, 1 to 3 percent slopes	39	49	36	51	25	35	14	19	1. 5	2. 1
Fordville loam, 3 to 5 percent slopes	36	44	33	48	23	33	13	18	1. 4	2. 0

[1] Yields of corn, oats, barley, and alfalfa are averages for the period from 1951 through 1956.

Managing Tame and Native Pasture

On farms it is particularly important that a balance be kept between the number of livestock and the pasture and the roughage produced. This balance is necessary to insure that feed for livestock is ample, that pastures are not overused, and that enough grazing is available throughout the growing season.

About 18 percent of the land area in Minnehaha County is pasture, of which about half is native pasture and about half is tame pasture.

Tame pasture

If the tame pasture in Minnehaha County is well managed, it can feed large numbers of beef cattle, dairy cattle, or sheep. Good management includes rotating pastures, appropriate stocking, fertilizing with nitrogen and phosphate, and controlling grazing. In controlled grazing, livestock is turned into a pasture after the plants have grown enough for grazing, and they are removed before the forage is overused. Other management practices are controlling weeds and brush and scattering droppings and clippings.

A plan for grazing should be selected that will provide green plants throughout the growing season. For example, sudangrass may be seeded at a time that allows enough growth for grazing during the hot summer months, and cool-season grasses may be planted so that they can be grazed in spring and fall.

In planning for better grass crops, the farmer can refer to the soil map and identify the soils on his farm. Then he can determine the limitations that affect their management. Because no two fields are alike, each field may need different management, different kinds of grass, or both. Some soils are wet; others are dry. Some soils are clayey; others are sandy. Each kind of soil should be planted to the kind of pasture plants that grow best on that soil.

The plans for a better grass crop are also affected by the use that is to be made of the crop. It is important to know whether the grasses and legumes will be used for hay, pasture, or silage; whether they will be on the soil for 1 year or for a longer period; or whether they will be used to control erosion. A list of good grass mixtures, advice about seedbed preparation, and time and method of planting can be obtained from the local soil conservationist, the county agricultural agent, or the State Agricultural Experiment Station.

Native pasture[2]

Most of the wild, or native, pasture of Minnehaha County is in small areas on farms. A few large areas of native pasture occur in the more rolling areas along the Big Sioux River, on breaks of smaller streams, and in areas around potholes. Most of the soils in native pasture are in capability classes V, VI, and VII.

The soils in native pasture generally are not suitable for cultivation, but they can produce good native grasses year after year. Like any other crop, a native grass responds to good care and management. When native pastures are in excellent condition, warm-season grasses are mostly produced. Most of the native pasture in Minnehaha County is overgrazed, however, and cool-season grasses have invaded and replaced warm-season grasses.

Warm-season native pasture complements cool-season tame pasture, and together these pastures provide grazing plants for a long period. When the native pasture deteriorates in summer, it is invaded by cool-season Kentucky bluegrass. By midsummer the Kentucky bluegrass is dormant, and the grazing period is shortened unless supplemental tame pasture is available. Sudangrass is one of the better tame grasses used for supplemental pasture. If it is available for grazing, it offsets the midseason slump of native pasture.

When the native pasture is in the midsummer slump, the livestock on it can be removed or reduced to a number that will graze not more than half of the yearly volume of herbage. The livestock removed from the native pasture can be turned onto supplemental tame pasture. Reducing the number of livestock on the native pasture permits desirable plants to make a complete cycle of growth and to be strong the following year. Some of the desirable plants that will increase and improve the condition of the native pasture are big bluestem, little bluestem, Indiangrass, switchgrass, and sideoats grama. By following this system of grazing each year, high annual production of forage can be maintained.

If not more than half the current year's growth of herbage is grazed, the better plants do not deteriorate and the pasture improves. The herbage left on the ground does these things—

1. Serves as a mulch that increases water intake so that more water is stored to supply growing plants.
2. Allows roots to grow deeper than they would in overgrazed pasture and to reach deep moisture.
3. Protects the soil from erosion by wind and water.
4. Helps the better grasses to crowd out undesirable plants.
5. Enables plants to store food that enables them to recover and grow vigorously after droughts and in spring.
6. Holds snow where it falls so that water from melting snow soaks into the soil.
7. Provides a greater feed reserve for dry periods.

In good pasture management grazing is adjusted from season to season according to forage production. Different soils produce different kinds and amounts of native grasses. If native pasture is to be well managed, the kinds of soil in each pasture ought to be known, as well as the kinds of plants that grow best on each soil. Then the pasture can be managed to encourage the growth of the best forage plants so that production is increased and the stand is improved.

Range condition can be rated by comparing the amount and kinds of native plants growing on a pasture with the amount and kinds that grew on it originally. Four classes are recognized. A pasture is in *excellent* condition if 76 to 100 percent of its vegetation is the kind that grew on it originally. Condition is *good* if this percentage is 51 to 75; it is *fair* if the percentage is 26 to 50; and it is *poor* if the percentage is 0 to 25.

[2] By L. R. ALBEE, assistant State soil conservationist, Soil Conservation Service.

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If a livestock producer knows the condition of the native pasture, he can manage it by applying the combination of practices that will increase production or keep it high. These practices include controlled grazing, brush control, seeding if needed, and contour furrowing.

Managing Soils for Windbreaks [8]

Minnehaha County originally was a rolling prairie. Trees grew only on flood plains along the main streams. They were mainly cottonwoods, several kinds of willows, American elm, and some hackberry and bur oak. Along with these trees were chokecherry, wild plum, and other shrubs. These native trees and shrubs had little or no commercial value. Practically all trees growing on uplands in this county have been planted.

The county is made up largely of soils in glacial and loessal material. Within some areas these soils differ in short distances. Erodibility varies widely from place to place. During the long, severe winters, the bare soils are especially susceptible to wind erosion unless they are protected. A relatively high average velocity of surface wind increases the erosion hazard. Farmsteads may be damaged by drifting snow. Because of these conditions, windbreaks to protect fields, farmsteads, and feedlots are beneficial and are needed on many farms.

Most trees and shrubs grow best on one kind of soil, but some grow well on many different kinds of soils. To successfully establish a windbreak on any planting site, it is necessary not only to eliminate the native vegetation but also to select only those trees and shrubs that grow well on the soil at that site.

Hardy stock from a local nursery should be carefully selected and planted on a well-prepared site. After the trees are planted, they should be cultivated to prevent competition from weeds and grass. The area should be protected from fire and grazing and the trunks of trees and shrubs from gnawing by rabbits and mice.

Although evergreens grow slowly, they are long lived and more effective in windbreaks than deciduous trees. They are also more decorative than those trees.

To be most effective, a windbreak should be planted in three or more rows.

The soils in Minnehaha County on which planted trees grow successfully have been placed in five windbreak suitability groups. These groups were determined by evaluating trees and soils in approximately 40 shelterbelts in the southeastern part of South Dakota where the climate and the soils are similar to the climate and soils in Minnehaha County. The average age of the trees in these shelterbelts was 21 years. Evaluations clearly show that the kind of soil is important to the success or failure of many woody plants. Consequently, the relation between the soils and trees should be considered when the composition of windbreaks is planned for a planting site (fig. 14). In the following pages the soils in the windbreak suitability groups are listed, as well as the trees and shrubs suitable to the soils in each group. These trees and shrubs can be expected to grow if the soils in the groups are managed well.

[8] This subsection was written by A. L. FORD, woodland conservationist, Soil Conservation Service.

Figure 14.—Excellent windbreak 9 years old on soils in glacial material.

WINDBREAK SUITABILITY GROUP 1

The only soils in windbreak suitability group 1 are in the Hecla-Hamar complex, which occupies only a small acreage in the county. These soils are deep and sandy, and their water table fluctuates. In most places the Hamar soils are too wet for most trees and shrubs. If the windbreak is needed in a swale or low spot, which is likely to be wet, plant cottonwood, willow, and dogwood. These trees, however, are not suited to shallow soils.

Because of their effectiveness in windbreaks and their estimated lifespan, the trees and shrubs best suited to deep Hecla soils are American elm, boxelder, cottonwood, green ash, soft maple, willow, American plum, common lilac, Russian-olive, Tartarian honeysuckle, spruce (Black Hills, Colorado blue), three-leaf sumac, and eastern redcedar. Other trees and shrubs suitable for planting on these soils are Chinese (Siberian) elm, hackberry, honeylocust, caragana, cotoneaster, and ponderosa pine. The soil should be protected by cover crops before and after it is planted to trees.

A survey of well-managed windbreaks on the deeper Hecla soils showed that after 20 years all trees and shrubs mentioned were in good condition. American elm averaged 32 feet in height; boxelder, 30 feet; cottonwood, 47 feet; green ash, 29 feet; eastern redcedar, 14 feet; Russian-olive, 30 feet; and American plum, 8 feet. Cottonwood after 20 years were dying on the shallower Hecla soils.

WINDBREAK SUITABILITY GROUP 2

The soils in windbreak suitability group 2 range from clay to permeable loams. The clay soils receive water in addition to that received from precipitation, which may vary from year to year. The silt loams do not receive extra water and are typical upland soils.

The soils in this group are not so good as those in group 1 for trees, yet they produce good to excellent windbreaks. Cottonwood and willow do not grow well, and soft maple and Russian-olive are relatively short-lived. The soils are—

Alcester silt loam, 1 to 3 percent slopes.
Alcester silt loam, 3 to 5 percent slopes.
Athelwold silt loam.
Brookings silt loam.
Buse-Kranzburg loams, 5 to 9 percent slopes, eroded.
Buse-Kranzburg loams, 9 to 17 percent slopes, eroded.
Buse-Vienna loams, 5 to 9 percent slopes, eroded.
Crofton silt loam, 5 to 9 percent slopes, eroded.
Crofton silt loam, 9 to 17 percent slopes, eroded.
Crofton silt loam, 17 to 30 percent slopes.
Egeland loam, 1 to 3 percent slopes.
Egeland loam, 3 to 5 percent slopes.
Egeland loam, 5 to 9 percent slopes, eroded.
Estelline silt loam, 0 to 2 percent slopes.
Estelline silt loam, 3 to 4 percent slopes.
Flandreau loam, 1 to 3 percent slopes.
Flandreau loam, 3 to 5 percent slopes.
Flandreau loam, 3 to 5 percent slopes, eroded.
Flandreau loam, 5 to 9 percent slopes, eroded.
Fordville loam, 1 to 3 percent slopes.
Fordville loam, 3 to 5 percent slopes.
Kranzburg silty clay loam, 1 to 3 percent slopes.
Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes.
Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes.
Kranzburg-Buse loams, 3 to 5 percent slopes.
Kranzburg silty clay loam, 1 to 3 percent slopes.
Kranzburg silty clay loam, 3 to 5 percent slopes.
Kranzburg silty clay loam, 5 to 9 percent slopes, eroded.
Lamoure silty clay loam.
La Prairie complex.
La Prairie silt loam.
Luton clay.
Moody- Nora silty clay loams, 3 to 5 percent slopes.
Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded.
Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded.
Moody silty clay loam, 1 to 3 percent slopes.
Moody silty clay loam, 3 to 5 percent slopes.
Moody silty clay loam, moderately shallow, 0 to 2 percent slopes.
Nora-Crofton silt loams, 5 to 9 percent slopes, eroded.
Nora-Crofton silt loams, 9 to 17 percent slopes, eroded.
Sinai silty clay, 1 to 3 percent slopes.
Sinai silty clay, 3 to 5 percent slopes.
Trent silty clay loam.
Vienna silt loam, 1 to 3 percent slopes.
Vienna silt loam, 3 to 5 percent slopes.
Vienna silt loam, 5 to 9 percent slopes.
Vienna silt loam, 5 to 9 percent slopes, eroded.

Trees and shrubs best suited for windbreaks on these soils are American elm, boxelder, green ash, American plum, common lilac, Tartarian honeysuckle, three-leaf sumac, eastern redcedar, and ponderosa pine. Other trees and shrubs suitable for planting on these soils are Chinese (Siberian) elm, hackberry, honeylocust, caragana, cotoneaster, and spruce (Black Hills, Colorado blue).

Cover crops should be planted to protect the soil and the seedlings and to catch snow to provide more water.

Measurements of trees in windbreaks after 20 years show that all trees best suited for windbreaks were in good to excellent condition. The average height of the tallest trees for each kind was American elm, 30 feet; boxelder, 24 feet; Chinese (Siberian) elm, 39 feet; green ash, 24 feet; hackberry, 20 feet; American plum, 8 feet; Russian-olive, 19 feet; lilac, 7 feet; caragana, 10 feet; and eastern redcedar, 16 feet.

WINDBREAK SUITABILITY GROUP 3

In windbreak suitability group 3 are moderately fine textured and fine textured soils that have slow permeability. These soils have a tight clay subsoil. Their available moisture capacity is less than that in soils in groups 1 and 2, and trees and shrubs do not grow so well as they do on those soils. However, with clean cultivation and other good management, trees will grow into effective windbreaks. The soils are—

Benclare silty clay loam.
Corson silty clay, 1 to 3 percent slopes.
Corson silty clay, 3 to 5 percent slopes, eroded.
Corson silty clay, 5 to 9 percent slopes, eroded.

Trees and shrubs best suited for windbreaks on these soils are American elm, green ash, caragana, three-leaf sumac, and eastern redcedar. Other trees and shrubs suitable are Chinese (Siberian) elm, hackberry, American plum, and ponderosa pine.

Conditions for growth can be improved in some places by planting on the contour or by constructing a small dike around the windbreak to divert runoff.

If the windbreak is managed well, American elm trees reach an average height of 24 feet in 20 years; ash, 22 feet; redcedar, 15 feet; and caragana, 10 feet. After 20 years, these trees and shrubs are vigorous.

WINDBREAK SUITABILITY GROUP 4

In windbreak suitability group 4 are droughty soils that have a thin surface layer underlain by coarse materials. Because water storage is poor, trees do not grow well. They grow fairly well when young, but soon their vigor declines. The soils are—

Buse loam, 9 to 17 percent slopes.
Maddock loamy fine sand, 3 to 5 percent slopes, eroded.
Maddock loamy fine sand, 5 to 9 percent slopes, eroded.
Maddock loamy fine sand, 9 to 17 percent slopes, eroded.

Trees and shrubs best suited for these soils are Chinese (Siberian) elm, green ash, caragana, three-leaf sumac, eastern redcedar, and ponderosa pine. Other trees and shrubs suitable are hackberry and American plum.

Clean cultivation will help to keep the trees and shrubs growing.

WINDBREAK SUITABILITY GROUP 5

Soils of windbreak suitability group 5 generally are wet or poorly drained. These soils are—

Alluvial land.
Benclare silty clay loam, poorly drained.
Hidewood silty clay loam.
Hidewood silty clay loam, calcareous.
Trent-slickspot complex.

If the soil layer in which the tree roots are normally located—the top 2 feet—is saturated most of the year, trees will not grow. Some trees, however, will grow if the water table is high for 6 weeks or less when trees are dormant. Trees best suited to the soils in this group are cottonwood, willow, ash, and dogwood. If the windbreak site can be drained, trees suitable for soils in windbreak group 2 can be used.

Managing Soils for Wildlife [4]

The soils of Minnehaha County have greatly influenced the numbers and kinds of wildlife in the county. Before the county was settled by white men, the rich soils produced an abundance of vegetation needed by the wildlife

[4] By LeRoy A. Shearer, wildlife biologist, Soil Conservation Service.

of the prairie. As the county was settled and grassland was converted to cropland, the same rich soil produced crops abundantly and caused significant changes in the numbers and kinds of wildlife. Prairie grouse, bison, and other birds and animals disappeared, for they could not tolerate the proximity of man nor the change in vegetation. In their stead other kinds of wildlife came into the county or were introduced. The ring-necked pheasant was introduced, and deer, rabbit, squirrel, and many kinds of songbirds increased in number.

Minnehaha County has approximately 10,000 acres that can be classified as wildlife land. This area consists of gullies; steep, rocky breaks and knolls; streambanks; marshes; and lakes. Largely because of its topography, the Kranzburg-Parnell soil association, in the western third of the county, contains most of the area suitable for wildlife habitats that has not been cleared. In this association ring-necked pheasant and migratory waterfowl predominate. The migratory waterfowl are attracted by the many marshes and by areas that are intermittently wet, because the birds can feed and reproduce in these areas. Larger marshes that hold water throughout the year provide excellent waterfowl hunting.

Wetlands and their vegetation are important in keeping the number of pheasants in the county high. At the edge of most marshes and potholes, nesting cover is undisturbed, and in these wet areas the cattails, bulrushes, and phragmites, or weeds, provide unexcelled winter cover for the birds.

Native stands of timber along the Big Sioux River, Beaver Creek, and Split Rock Creek are excellent habitats for a large part of the county's deer. These stands are also used by a few pheasants. Both deer and pheasant can be found in farmstead and field windbreaks, in marshes, and in small areas of brush in draws.

Other wildlife in the county are fox, rabbit, dove, muskrat, and many kinds of songbirds.

Small numbers of fish are in the Big Sioux River, Split Rock Creek, and in the lower parts of Skunk Creek. Additional fishing is provided by Clear Lake and Wall Lake, but fishing in Mile Long Lake and Beaver Lake is sporadic. Bullhead, perch, and sunfish make up the largest part of the fish population in the county, and walleyed pike and northern pike are present in smaller numbers.

The construction of ponds for watering livestock has added small areas of fishing water throughout the county. Most of the fish stocked in these ponds are bass and bluegill.

Most of the wildlife in Minnehaha County is produced as a secondary crop in areas used primarily for agricultural crops. If a farmer wants to increase the wildlife on his farm to a maximum, he should do the following:

1. Fence the small area around farm ponds.
2. Protect odd areas, or plant them to grasses or shrubs.
3. Protect ponds from silting.
4. Plant in windbreaks the trees and shrubs that bear food for wildlife.
5. Avoid mowing waterways and field borders until after about July 1, when the nesting season is over.
6. Control grazing.
7. Avoid burning fence lines, corners, or sloughs.

Information on developing and improving wildlife habitats can be obtained from the local office of the Soil Conservation Service or from the South Dakota Department of Game, Fish, and Parks.

Engineering Uses of Soils [5]

The primary use of soil by engineers is for construction material. The engineer is interested, therefore, in those properties of the soil that determine its suitability as a building material, that limit its use in construction, or that make special handling necessary.

Some soil properties are of special interest to engineers because they affect construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, irrigation and drainage systems, and sewage disposal systems. The properties most important to the engineer are permeability to water, strength against shearing (shear strength), compaction characteristics, soil drainage, shrink-swell properties, texture, plasticity, and reaction. Other important properties are depth to water table, depth to bedrock, water-holding capacity, and topography.

This subsection gives soil data useful in engineering, correlates these data with soil mapping units, and interprets the data to aid the engineer in his search for soil information. Additional information can be found in the sections "Descriptions of Soils" and "Formation and Classification of Soils." Some terms used by soil scientists may be unfamiliar to engineers, and other terms may have a special meaning in soil science. These terms are defined in the Glossary at the end of the report.

Uses and limitations of soil survey report

This soil survey report contains information about the soils of Minnehaha County that can be used by engineers to—

1. Plan detailed soil investigations of selected locations.
2. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
3. Make preliminary estimates of the engineering properties of soils that will help in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
4. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, and utility locations.
5. Locate probable sources of gravel, sand, and other construction materials.

[5] The South Dakota Soil Engineering Interpretations Committee, composed of engineers of the South Dakota Department of Highways, the United States Bureau of Public Roads, South Dakota State College, and the Soil Conservation Service, collaborated with soil scientists of the Soil Conservation Service in preparing this subsection. The assistance given by personnel of the South Dakota Department of Highways was under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads.

6. Correlate performance of engineering structures with soil mapping units, and thus develop information that will be useful in designing and maintaining the structures.
7. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
8. Supplement the information obtained from other published maps, reports, and aerial photographs for the purpose of making soil maps and reports that can be readily used by engineers.
9. Make other preliminary estimates for construction purposes that are pertinent to the particular area.

The properties and characteristics of the soils discussed in this subsection are based on a number of samples, which have been tested by various agencies. Because sampling and testing are limited, and because soils vary within a short distance, complete, accurate information about the soils at a construction site cannot be obtained from this report. *The report does not eliminate the need for on-site sampling and testing for design and construction of specific engineering works and uses. It should be used primarily in planning more detailed field investigations to determine the condition of the soil, in place, at the proposed site of construction.*

Engineering interpretation of soils

Most of the information in this subsection is in tables 3, 4, 5, and 6. In table 3 test data are correlated with the soils of the county, which are shown on the detailed map at the back of this report. Table 4 interprets the test data in a form that engineers can use easily. Two tables give the test data on which the estimates of properties and the engineering interpretations are based. Table 5 lists test data for 5 soils in the county, and table 6 lists test data for 21 soil types, a soil complex, and a land type. Most testing procedures were according to the standard procedures of the American Association of State Highways Officials (*1*).[6] Each table is discussed in the following pages.

Table 3 describes briefly the profile of each soil in the county and lists physical characteristics that are significant to engineering. These estimates are based on laboratory tests conducted on soil samples. Also considered are other data obtained by the South Dakota Department of Highways in their program of soil exploration and soil testing.

In table 3 soils are classified according to the Unified (*14*) and the AASHO systems (*1*). The Unified system was established by the Corps of Engineers. It identifies soils on the basis of their texture, plasticity, and liquid limit. In the Unified system 15 soil groups are set up and are designated by letter symbols.

The AASHO classification is based on the bearing strength of soils. In this system soils are grouped in seven basic groups and five subgroups according to their serviceability and their capacity to carry a load. These groups and subgroups run from A–1 through A–7. The best soils for road subgrade, or soils of high bearing capacity, are classified A–1, the next A–2, and so on. The poorest soils are classified A–7–6. In recent years the basic soil groups and the subgroups have been further classified by adding a group index number ranging from 0 for the best material in soil groups A–1, A–2, and A–3 to 20 for the poorest material in group A–7. Soil groups can be classified by group index only by laboratory analyses that show the percentage of the soil passing the No. 200 sieve, the liquid limit, and the plasticity index.

The permeability of a soil is its ability to transmit water. Permeability in table 3 is for soil in place. It was estimated by considering soil structure and porosity, and the estimate was compared with the results obtained in permeability tests on undisturbed cores of similar soils.

The available water capacity in table 3 refers to the field capacity of the soil. When the soil is air dry, the amount of water listed will wet the soil to a depth of 1 inch without deeper percolation.

Dispersion as used in table 3 refers to the degree that the particles smaller than 0.005 millimeter are separated or dispersed. This is not the same condition as that of single-grain, or unaggregated, clean sand.

The shrink-swell potential shown in table 3 indicates the volume change to be expected in the soil material when the moisture content changes. This volume change depends on the amount and kind of clay. The shrink-swell potential is based on the liquid limit and plasticity index of the soil, which reflect the nature of the clay. The shrink-swell potential can be noted as low, moderate, or high. However, when determining the potential, both the liquid limit and the plasticity index should be considered for a possible range in classification. For example, a low liquid limit and a moderate plasticity index have a "low to moderate" shrink-swell potential. The shrink-swell potential is low when the liquid limit is 30 or less and the plasticity index is 10 or less; it is moderate when the liquid limit is 31 to 40 and the plasticity index is 11 to 20; it is high when the liquid limit is 41 to 60 and the plasticity index is 21 to 40; and it is very high when the liquid limit is more than 60 and the plasticity index is more than 40.

Because only two soils in the county are saline, salinity is not given in table 3. Rauville silty clay loam is slightly saline, and Lamoure silty clay loam is slightly saline in some places.

Table 4 rates, for each soil series and for some land types, the suitability of soil material for certain uses and lists important features that affect the design of structures and the application of practices. These features have been evaluated from the estimated data in table 3 and from the test data in tables 5 and 6.

The susceptibility of soil to frost action depends on the texture of the soil materials and the height of the water table at the time of freezing. Silt and fine sand with a high water table are rated highly susceptible.

The suitability of soil material for road fill depends largely on the texture of the material and its content of natural water. Highly plastic soil materials that have a high content of natural water are rated "poor." Highly erosive soils (silt and fine sand) are difficult to compact, require moderately gentle slopes, and need rapid coverage of plants. Therefore, they are rated "fair."

[6] Italic numbers in parentheses refer to Literature Cited, p. 98.

TABLE 3.—*Description of soils and*

[Absence of data indi-

Symbol on map	Soil [2]	Description of soils	Depth from surface	Classification
				USDA texture
			Inches	
AcA AcB	Alcester silt loam, 1 to 3 percent slopes. Alcester silt loam, 3 to 5 percent slopes.	Moderately well drained, medium-textured and moderately fine textured soils in colluvial and alluvial sediments in narrow upland valleys and on foot slopes; substratum is mainly silt or loamy glacial till with stratified sand and gravel in places. Subject to gullying and to occasional flooding.	0 to 60	Silt loam to silty clay loam.
An	Alluvial land.	Medium-textured to moderately fine textured soils in alluvial sediments in fairly level, narrow upland valleys, in drainageways and swales, and on toe slopes; substratum is generally silt or loamy glacial till with stratified sand and gravel in places. Subject to flooding, gullying, and sedimentation.	0 to 60	Loam to silty clay loam.
Ar	Alluvial land, rocky.	Soils of variable texture in alluvial sediments on nearly level, frequently flooded plains that have a change of sediments with each flood; stony and shallow to rock, with rock outcrops in many places; high water table.		
At	Athelwold silt loam.	Moderately well drained, medium-textured soil on nearly level areas and in slight depressions on uplands, on stream terraces, at the head of drainageways, and at the base of gentle slopes; substratum of medium to coarse sand and gravel.	0 to 40 40 to 60	Silt loam Fine sand
Bc Bd	Benclare silty clay loam. Benclare silty clay loam, poorly drained.	Moderately well drained, moderately fine textured soils that have a finer textured subsoil and substratum; on old stream terraces.	0 to 19 19 to 31 31 to 60	Silty clay loam to silty clay. Silty clay loam Silty clay to clay
Be	Brookings silt loam.	Moderately well drained, medium-textured to moderately fine textured soil over glacial till in nearly level areas and in slight depressions on uplands.	0 to 45 45 to 65	Silt loam to silty clay loam. Silty clay loam
BmD BnE BoD	Buse loam, 9 to 17 percent slopes. Buse soils, steep. Buse stony loam, 5 to 17 percent slopes.	Thin, medium-textured soils in glacial till on uplands; scattered gravel, stones, and an occasional boulder on surface. Subject to erosion.	0 to 5 5 to 60	Loam Silty clay loam to silty clay.
CoA CoB2 CoC2	Corson silty clay, 1 to 3 percent slopes. Corson silty clay, 3 to 5 percent slopes, eroded. Corson silty clay, 5 to 9 percent slopes, eroded.	Well-drained, slowly permeable, fine-textured soils in loess or alluvial clayey material on uplands. Subject to erosion in sloping areas.	0 to 5 5 to 19 19 to 24 24 to 41 41 to 60	Silty clay Silty clay Clay Silty clay Silty clay
CrC2 CrD2 CrE	Crofton silt loam, 5 to 9 percent slopes, eroded. Crofton silt loam, 9 to 17 percent slopes, eroded. Crofton silt loam, 17 to 30 percent slopes.	Thin, excessively drained, medium-textured soils in loess on uplands; limy at or near the surface. Very erosive.	0 to 60	Silt loam
Dm	Dimmick clay.	Very poorly drained, fine-textured soil in clayey alluvium in nearly level depressions on flood plains; high water table.	0 to 60	Clay
EgA EgB	Egeland loam, 1 to 3 percent slopes. Egeland loam, 3 to 5 percent slopes.	Well-drained, medium-textured to moderately fine textured soils in loess on uplands and high	0 to 15	Loam

See footnotes at end of table.

estimated physical properties [1]

cated by dashed lines]

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
Unified	AASHO	No. 10	No. 40	No. 200					
					Inches per hour	*Inches per inch of depth*	*(pH)*		
ML to CL	A-7-6 or A-6	96 to 100	87 to 100	64 to 99	0.80 to 2.50	0.20	6.5 to 9.0	Low	Moderate.
ML or CL	A-7-6 to A-6	95 to 100	85 to 100	60 to 99	0.80 to 2.50	.20	6.5 to 8.4	Low	Moderate to high.
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CL	A-7	95 to 100	85 to 100	60 to 99	0.80 to 2.50	.17	5.6 to 6.5	Low	Moderate.
SP or GP	A-4 to A-2	96 to 100	47 to 98	10 to 85	2.50 to 5.00	.10	8.5 to 9.0	Low	Low.
CH	A-7-6	100	99 to 100	96 to 100	0.20 to 0.80	.22	5.6 to 6.8	Low	High.
CL	A-7-6	100	98 to 100	94 to 98	0.20 to 0.80	.22	6.9 to 7.2	Low	High.
CH	A-7-6	100	99 to 100	94 to 100	0.20 to 0.80	.22	7.0 to 8.2	Low	High.
ML	A-7-6	91 to 99	72 to 94	51 to 58	0.80 to 2.5	.20	6.6 to 7.3	Low	Moderate.
CL	A-6	95 to 100	88 to 96	69 to 89	0.50 to 1.50	.20	8.5 to 9.0	Low	Moderate.
CL	A-6	93 to 98	86 to 87	56 to 60	0.80 to 2.50	.19	7.4 to 7.6	Low	Moderate.
CL	A-6	97 to 100	90 to 99	68 to 98	0.50 to 1.50	.19	7.7 to 7.9	Low	Moderate.
CH	A-7-6	100	98 to 100	90 to 100	0.05 to 0.20	.22	6.6 to 6.8	Low	High.
CH	A-7-6	100	96 to 100	90 to 100	0.05 to 0.20	.22	7.8 to 8.0	Low	High.
CH	A-7-6	100	96 to 100	92 to 100	0.05 to 0.20	.22	8.3 to 8.5	Low	High.
CH	A-7-6	100	97 to 100	94 to 100	0.05 ot 0.20	.22	8.3 to 8.5	Low	High.
CH	A-7-6	100	99 to 100	96 to 100	0.05 to 0.20	.22	8.3 to 8.5	Low	High.
CL	A-6	96 to 100	89 to 98	85 to 100	0.80 to 2.50	.19	8.2 to 8.7	Low	Moderate.
CL-CH	A-7	95 to 100	85 to 100	80 to 99	0.05 to 0.20	.22	6.4 to 9.0	Low	High.
ML or CL.	A-6 to A-4	99 to 100	77 to 98	28 to 80	0.80 to 2.50	.20	7.3 to 7.7	Low	Moderate.

See footnotes at end of table.

TABLE 3.—*Description of soils and their*

[Absence of data indi

Symbol on map	Soil [2]	Description of soils	Depth from surface	Classification
				USDA texture
			Inches	
EgC2	Egeland loam, 5 to 9 percent slopes, eroded.	stream terraces; substratum of water-deposited sand and gravel. Erosive.	15 to 38	Sandy loam and coarse sandy loam.
			38 to 67	Coarse sand
EsA	Estelline silt loam, 0 to 2 percent slopes.	Well-drained, medium-textured soils on stream terraces in loess about 28 to 50 inches thick that overlies sand and gravel. Erosive on gentle slopes.	0 to 46	Silt loam and silty clay loam.
EsB	Estelline silt loam, 3 to 4 percent slopes.		46 to 64	Fine sand and sand.
FaA	Flandreau loam, 1 to 3 percent slopes.	Well-drained, medium-textured soils in loess about 36 inches thick over sands. Erosive.	0 to 36	Loam to silt loam
FaB	Flandreau loam, 3 to 5 percent slopes.		36 to 60	Coarse sandy loam to loamy sand.
FaB2	Flandreau loam, 3 to 5 percent slopes, eroded.			
FaC2	Flandreau loam, 5 to 9 percent slopes, eroded.			
HH	Hecla-Hamar complex:			
	Hecla component.	Moderately well drained sandy soil in alluvium reworked by wind on somewhat hummocky high flood plains or low stream terraces; substratum of water-deposited sand, gravel, or clay.	0 to 16	Fine sandy loam to sandy loam.
			16 to 32	Loamy sand
			32 to 60	Fine sandy loam
	Hamar component.	Poorly drained loamy soil with sandy substratum. Occurs in level positions, swales, and depressions on high bottom lands or low stream terraces. Has a fluctuating high water table. Substratum of stratified sands and gravel.	0 to 39	Loam to sandy loam.
			39 to 52	Clay loam
			52 to 60	Coarse sand to gravel.
Hw	Hidewood silty clay loam.	Somewhat poorly drained, moderately fine textured soils in colluvial sediments in upland swales, depressions, and at the heads of drainageways; water runs in and is ponded in places.	0 to 60	Silt loam to clay loam.
Hy	Hidewood silty clay loam, calcareous.			
KrA	Kranzburg silty clay loam, 1 to 3 percent slopes.	Well-drained, moderately thick soils formed in loesslike material; nearly level to rolling; moderately fine textured; substratum of glacial till. Soils of the uplands and subject to runoff and erosion.	0 to 5	Silty clay loam
KrB	Kranzburg silty clay loam, 3 to 5 percent slopes.		5 to 27	Silty clay loam
KrC2	Kranzburg silty clay loam, 5 to 9 percent slopes, eroded.		27 to 60	Silt loam to clay loam.
La	Lamoure silty clay loam.	Somewhat poorly drained, moderately fine textured soil in alluvial sediments on stratified gravel; occurs on nearly level flood plains; substratum is sand and silt. Subject to flooding.	0 to 29	Silty clay loam
			29 to 40	Silt loam
			40 to 60	Sand and gravel
Ls	La Prairie silt loam.	Moderately well drained, medium-textured soil in alluvial sediments on nearly level flood plains; substratum of stratified sand, silt, and gravel. Subject to flooding.	0 to 40	Silt loam to loam
			40 to 62	Sandy loam
Lu	Luton clay.	Somewhat poorly drained, fine-textured soil in alluvium on nearly level flood plains. Subject to flooding.	0 to 7	Silty clay
			7 to 60	Silty clay loam to silt loam.
			60 to 65	Sandy loam
MdB2	Maddock loamy fine sand, 3 to 5 percent slopes, eroded.	Somewhat excessively drained, moderately coarse textured soils in wind-deposited or outwash sands on sloping to steep uplands; substratum of fine sand.	0 to 6	Loamy fine sand
MdC2	Maddock loamy fine sand, 5 to 9 percent slopes, eroded.		6 to 20	Loamy sand
			20 to 65	Fine sand
MdD2	Maddock loamy fine sand, 9 to 17 percent slopes, eroded.		< 65	Coarse sand to fine sand.

See footnotes at end of table.

estimated physical properties [1]—Continued

cated by dashed lines]

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
Unified	AASHO	No. 10	No. 40	No. 200					
					Inches per hour	*Inches per inch of depth*	*(pH)*		
SM or SC.	A-6 to A-2-4	97 to 100	47 to 98	15 to 79	2.50 to 5.00	0.16	7.0 to 8.0	Low	Low.
SP-SM	A-2-4 to A-1-b.	93 to 100	36 to 98	8 to 84	5.00 to 10.00	.12	9.0 to 9.2	Low	Low.
ML or CL	A-6 to A-6	83 to 100	60 to 100	25 to 97	1.50 to 5.00	.20	5.6 to 7.3	Low	Moderate.
SW or SM	A-1-b to A-2-4.	46 to 100	15 to 64	2 to 17	5.00 to 10.00	.12	7.5 to 9.0	Low	Low.
CL	A-6	91 to 100	78 to 94	38 to 78	1.50 to 5.00	.20	6.6 to 8.4	Low	Moderate.
SC	A-2-6	88 to 100	63 to 71	17 to 42	5.00 to 10.00	.14	8.5 to 9.0	Low	Moderate.
SM to SC	A-2-4	80 to 100	50 to 75	15 to 35	2.50 to 5.00	.16	5.6 to 6.0	Low	Low.
SM	A-2	80 to 100	50 to 75	15 to 35	2.50 to 5.00	.16	6.6 to 7.3	Low	Low.
SM	A-2	96 to 100	50 to 75	10 to 49	2.50 to 5.00	.16	7.9 to 8.4	Low	Low.
ML to SM.	A-6 to A-2	98 to 100	65 to 97	25 to 80	0.80 to 2.50	.18	5.6 to 7.3	Low	Low to moderate.
CL	A-6	97 to 100	90 to 99	70 to 85	0.50 to 1.50	.20	6.6 to 7.3	Low	Moderate.
SP to GP	A-4 to A-2	96 to 100	47 to 98	10 to 85	5.00 to 10.00	.14	4.5 to 5.0	Low	Low.
ML to CL	A-7-6 to A-6	97 to 100	90 to 99	65 to 93	0.20 to 0.80	.21	6.6 to 7.6	Low to moderate.	Moderate to high.
ML	A-7-5	95 to 100	86 to 100	59 to 96	0.80 to 2.50	.21	5.8 to 6.8	Low	Moderate.
ML or CL	A-7-6 to A-6	92 to 100	75 to 100	45 to 99	0.80 to 2.50	.21	6.0 to 8.5	Low	Moderate.
CL	A-7-6 to A-6	80 to 100	67 to 100	50 to 99	0.80 to 2.50	.21	8.0 to 9.0	Low	Moderate.
ML or CL	A-7-6	95 to 100	85 to 100	75 to 98	0.80 to 2.50	.21	6.6 to 9.0	Low	Moderate.
ML or CL	A-6	92 to 100	76 to 99	49 to 97	0.80 to 2.50	.21	6.6 to 9.0	Low	Moderate.
SP or GP	A-4 to A-2	96 to 100	45 to 98	10 to 48	5.00 to 10.00	.14	6.6 to 9.0	Low	Low.
ML or CL	A-6	94 to 100	70 to 100	24 to 97	0.80 to 2.50	.20	6.1 to 9.0	Low	Moderate.
SM or SC	A-2-4 to A-1-b.	89 to 100	33 to 100	6 to 75	2.50 to 5.00	.17	8.5 to 9.0	Low	Low.
CH	A-7-6	98 to 100	87 to 99	58 to 97	0.20 to 0.80	.22	5.6 to 6.0	Low to moderate.	High.
CL	A-6	97 to 100	79 to 99	31 to 97	0.20 to 0.80	.22	6.6 to 8.4	Low to moderate.	Moderate.
SW or SM	A-3	76 to 99	28 to 94	6 to 17	2.50 to 5.00	.16	7.9 to 8.4	Low to moderate.	Low.
SC	A-6	96 to 100	82 to 94	3 to 89	2.50 to 5.00	.12	6.6 to 7.3	Low	Moderate.
CL to SC	A-6 to A-2-4	96 to 100	84 to 95	26 to 81	1.50 to 3.50	.16	7.4 to 7.8	Low	Moderate.
SM	A-2-4	87 to 100	55 to 87	6 to 25	2.50 to 5.00	.12	7.9 to 8.4	Low	Low.
SP or SW	A-2-4 to A-1-b.	96 to 100	40 to 95	0 to 35	5.00 to 10.00	.10	7.9 to 8.4	Low	Low.

See footnotes at end of table.

TABLE 3.—*Description of soils and their*

[Absence of data indi

Symbol on map	Soil [2]	Description of soils	Depth from surface	Classification
				USDA texture
			Inches	
MoA MoB MsA	Moody silty clay loam, 1 to 3 percent slopes. Moody silty clay loam, 3 to 5 percent slopes. Moody silty clay loam, moderately shallow, 0 to 2 percent slopes.	Well-drained, medium-textured and moderately fine textured soils in loess on uplands; substratum of silt loam but in places rock is at a depth of about 40 inches. Subject to runoff and erosion on gentle slopes.	0 to 42 42 to 60	Silty clay loam to silt loam. Silt loam
NCC2 NCD2	Nora-Crofton silt loams, 5 to 9 percent slopes (Nora component). Nora-Crofton silt loams, 9 to 17 percent slopes (Nora component).	Well-drained, medium-textured soils in loess on uplands. Subject to runoff and erosion.	0 to 38 38 to 67	Silt loam Silt loam
Pa	Parnell silty clay loam.	Very poorly drained, moderately fine textured to fine textured soil in colluvial and alluvial sediments in depressions or potholes on uplands; substrata is usually glacial clay loam.	0 to 36 36 to 50 50 to 60	Silty clay loam to silt loam. Silty clay to silty clay loam. Loam
Ra	Rauville silty clay loam.	Very poorly drained, moderately fine textured and fine textured soil in alluvial sediments of depressions and old stream channels on flood plains; covered by water for long periods; substratum of clay.	0 to 60	Silty clay loam to clay.
Ro	Rock land.	Areas of rock outcrops, canyon walls, and large boulders.		
SnA SnB	Sinai silty clay, 1 to 3 percent slopes. Sinai silty clay, 3 to 5 percent slopes.	Well-drained, fine-textured soils in loess on the flat tops of rounded hills; substratum of firm glacial till. Subject to runoff and slight erosion on gentle slopes.	0 to 8 8 to 19 19 to 60	Silty clay Silty clay Silty clay loam
BS	Sioux soils (in Buse-Sioux complex).	Excessively drained, rolling to steep, medium-textured to coarse-textured soils on uplands and stream terraces; substratum of sand and gravel.	0 to 4 4 to 8 8 to 60	Gravelly loam Sandy loam Gravel
Te	Terrace escarpments.	Excessively drained, rolling and steep soils that are shallow over gravel or over clayey material on breaks of stream terraces.		
Tr	Trent silty clay loam.	Moderately well drained, moderately fine textured soil in loess on nearly level uplands.	0 to 39 39 to 113	Silty clay loam Silt loam
VnA VnB VnC VnC2	Vienna silt loam, 1 to 3 percent slopes. Vienna silt loam, 3 to 5 percent slopes. Vienna silt loam, 5 to 9 percent slopes. Vienna silt loam, 5 to 9 percent slopes, eroded.	Well-drained, level to sloping, medium-textured soils in glacial till on uplands. Subject to runoff and erosion.	0 to 15 15 to 60	Silt loam to loam Clay loam
WeA WeB	Fordville loam, 1 to 3 percent slopes. Fordville loam, 3 to 5 percent slopes.	Well-drained, nearly level to gently sloping, medium-textured soils in alluvium on stream terraces; substratum of stratified gravel at a depth of about 30 inches.	0 to 8 8 to 29 29 to 60	Loam Silt loam to loam Coarse sand to gravel.

[1] The physical properties are estimated on the basis of laboratory tests on five modal soils by the South Dakota Department of Highways. The estimates apply only to the soils in Minnehaha County.

estimated physical properties [1]—Continued

cated by dashed lines]

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
Unified	AASHO	No. 10	No. 40	No. 200					
					Inches per hour	*Inches per inch of depth*	*(pH)*		
ML or CL	A–7–6 to A–6	95 to 100	88 to 100	78 to 99	0.80 to 2.50	0.21	5.6 to 8.4	Low	Moderate.
CL	A–6	99 to 100	98 to 100	93 to 99	0.80 to 2.50	.21	5.6 to 8.4	Low	Moderate.
ML or CL	A–7–6 to A–6	96 to 100	96 to 100	86 to 99	0.80 to 2.50	.20	6.5 to 9.0	Low	Moderate.
ML or CL	A–6 to A–4	96 to 100	84 to 100	40 to 99	0.80 to 2.50	.20	6.5 to 9.0	Low	Low to moderate.
ML to CL	A–7–6	95 to 100	85 to 100	75 to 98	0.80 to 2.50	.22	5.3 to 6.9	Low to moderate.	Moderate.
CL to CH	A–7–6	95 to 100	85 to 100	80 to 99	0.20 to 0.80	.22	6.6 to 7.3	Low to moderate.	Moderate to high.
ML to CL	A–7 to A–6	95 to 100	88 to 100	78 to 99	0.20 to 0.80	.22	6.6 to 7.3	Low to moderate.	Moderate.
ML to CL	A–7–6 to A–6	95 to 100	90 to 100	75 to 99	0.05 to 0.20	.22	7.4 to 7.8	Low to moderate.	High.
ML to CL	A–7–6	99 to 100	92 to 97	76 to 86	0.20 to 0.80	.22	6.3 to 6.9	Low to moderate.	Moderate.
MH to CH	A–7–6	91 to 100	89 to 99	79 to 86	0.20 to 0.80	.22	7.7 to 8.1	Low to moderate.	High.
ML to CL	A–7–6	85 to 100	63 to 99	45 to 93	0.20 to 0.80	.22	8.5 to 9.0	Low to moderate.	Moderate.
ML to GM	A–7 to A–2	85 to 95	50 to 80	0 to 50	5.00 to 10.00	.08	6.6 to 8.8	Low	Low.
ML to SM	A–6 to A–2	90 to 100	55 to 85	0 to 50	5.00 to 10.00	.08	6.6 to 8.8	Low	Low.
GW or GP	A–2 to A–1	70 to 90	30 to 80	0 to 35	5.00 to 10.00	.08	6.6 to 8.8	Low	Low.
ML or CL	A–7–6 to A–7–5.	100	99 to 100	90 to 100	0.80 to 2.50	.21	6.6 to 9.0	Low	Moderate.
ML or CL	A–6 to A–4	99 to 100	99 to 100	97 to 98	0.80 to 2.50	.21	6.6 to 9.0	Low	Moderate.
CL	A–7–6	98 to 100	92 to 100	69 to 94	0.80 to 2.50	.20	6.1 to 7.8	Low	Moderate.
CL	A–7–6 to A–6	97 to 98	90 to 94	70 to 75	0.80 to 2.50	.20	7.8 to 9.0	Low	Moderate.
ML	A–6	78 to 100	54 to 94	31 to 85	0.80 to 2.50	.20	6.6 to 7.3	Low	Moderate.
CL	A–6	97 to 100	87 to 98	66 to 94	0.80 to 2.50	.20	7.0 to 8.0	Low	Moderate.
SM or GP	A–2–4 to A–1–b.	58 to 100	27 to 99	7 to 46	3.75 to 7.50	.16	8.3 to 9.0	Low	Low.

[2] Most soil complexes not listed. Their properties can be determined by referring to the soils in the complexes.

TABLE 4.—*Engineering*

[Dashed lines indicate that structure is not

Soil series and map symbol [1]	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil	Sand and gravel	Road fill	Highway location	Dikes or levees
Alcester (AcA, AcB)	High	Good to a depth of 2 feet.	Not suitable; thin layers.	Fair; side slopes erode easily.	Slopes erode easily; resistance to shearing in foundation may be low when soil is saturated. Fair suitability.	Steep side slopes erode easily. Fair suitability.
Alluvial land (An)	High	Poor to good at a depth of 2 feet.	Not suitable	Poor to fair; steep side slopes erode easily.	Steep slopes erode easily; resistance to shearing in foundation may be low when saturated; frequent flooding. Fair suitability.	Steep side slopes subject to erosion. Fair suitability.
Alluvial land, rocky (Ar).	Not susceptible.	Not suitable; quartzite outcrop.	Not suitable; quartzite outcrop.	Excellent; shallow to quartzite.	High water table; stones and boulders may be scattered over surface. Poor suitability.	----------
Athelwold (At)	Slight to medium.	Fair to a depth of 14 inches.	Some areas may be suitable for sand and gravel.	Fair to good; sand and gravel at a depth of about 40 inches.	Resistance to shearing in foundation may be low when soil is saturated. Fair suitability.	Loamy upper layers good for embankment but underlying material is sand and gravel. Fair suitability.
Benclare (Bc, Bd)	Medium	Fair to a depth of 8 inches.	Not suitable	Fair; impervious, plastic clay.	Resistance to shearing in foundation may be low when soil is saturated. Fair suitability.	Shrink-swell potential high. Fair suitability.
Brookings (Be)	Medium	Good to a depth of 14 inches.	Not suitable	Fair; high embankments may have poor stability.	When saturated, layer above glacial till may be unstable. Fair suitability.	----------
Buse (BmD, BnE, BoD).	Medium	Not suitable	Not suitable	Fair; slopes erode easily.	Steep slopes and boulders on surface. Fair to good suitability.	----------
Corson (CoA, CoB2, CoC2).	Medium	Fair; surface layer thin in eroded areas.	Not suitable	Fair; steep side slopes subject to erosion.	Slopes erode easily; resistance to shearing in foundation may be low when soil is saturated. Fair suitability.	----------
Crofton (CrC2, CrD2, CrE).	Moderately to highly susceptible.	Poor; thin, limy surface layer.	Not suitable	Fair; steep side slopes erode easily.	Some steep slopes; fair suitability.	----------
Dimmick (Dm)	Moderately susceptible.	Fair; high water table.	Not suitable	Poor; high content of moisture; plastic clay.	Water table usually at a depth of 3 feet. Poor suitability. Plastic clay.	High content of moisture likely. Poor suitability.

See footnote at end of table.

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Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Stratified sand and gravel that cause seepage.	Slopes erode easily; resistance to shearing may be low when soil is saturated. Fair suitability.	Some stratified sand and gravel.	-------------------	Erosive at outlets of terraces and diversions.	Erosive; maintenance is important.
Stratified sand and gravel that cause seepage.	Slopes erode easily; resistance to shearing may be low when soil is saturated. Fair suitability.	Some stratified sand and gravel.	-------------------	Erosive at outlets of terraces and diversions.	Erosive; maintenance is important.
-------------------	-------------------	-------------------	Shallow quartzite substratum.	Shallow to quartzite substratum.	Shallow to quartzite.
Sand and gravel at about a depth of 40 inches may cause seepage. Fair to poor suitability.	Resistance to shearing may be low when soil is saturated. Fair suitability.	Water table usually below 3 feet. Depressions may need surface drainage.	Surface depressions may need drainage.	-------------------	
Impervious, but may have seams of sand. Good suitability.	High shrink-swell potential; use only in center core; resistance to shearing may be low when soil is saturated. Fair suitability for use as soil core.	Slow permeability; some areas receive run-in water and need drainage.	Some areas impermeable.	Slow permeability; gradient terraces needed on steeper slopes.	
May have seams of sand immediately above glacial till. Normally good suitability.	Resistance to shearing may be low when soil is saturated. Fair suitability.	Stratified sands and gravels; depressions may need surface drainage.	Glacial till too near surface in most places.	-------------------	
Generally impervious; varies locally.	Slopes erode easily and boulders are on surface. Fair to good suitability.	-------------------	Steep topography and glacial till.	Much of area too steep, too stony, or both, for terraces or diversions.	Erosive soil; maintenance is important.
Site selection difficult because of topography. Fair suitability.	Resistance to shearing may be low when soil is saturated. Fair suitability.	Good surface drainage; slow internal drainage.	Slow permeability; may need internal drainage.	Slow permeability; gradient terraces needed on sloping areas.	Erosive soil; maintenance important.
Seams of sand immediately above glacial till in some places.	Resistance to shearing may be low when soil is saturated. Fair suitability.	-------------------	Steep topography----	Steep slopes; level or gradient terraces needed.	Highly erosive soil.
Poorly drained flats and depressions. Good for dugout ponds.	High content of moisture. Poor suitability.	Depressions need drainage.	-------------------	-------------------	

See footnote at end of table.

TABLE 4.—*Engineering*

[Dashed lines indicate that structure is not

Soil series and map symbol [1]	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil	Sand and gravel	Road fill	Highway location	Dikes or levees
Egeland (EgA, EgB, EgC2).	Slightly to moderately susceptible.	Fair to a depth of 9 inches.	Some areas may be suitable for fine sand; not suitable for gravel.	Fair to good; stratified fine sand.	Steep slopes erode easily; resistance to sliding may be low. Fair to good suitability.	Excessive permeability below 30 inches. Poor to fair suitability.
Estelline (EsA, EsB).	Slightly to highly susceptible.	Good to a depth of 7 inches.	Some areas may be suitable for sand and gravel.	Fair to excellent; sand and gravel to a depth of 28 to 50 inches.	Slopes erode easily; resistance to shearing may be low when soil is saturated. Fair suitability.	----------------
Flandreau (FaA, FaB, FaB2, FaC2).	Slightly to moderately susceptible.	Good to a depth of 7 inches.	Some areas may be suitable for sand at a depth of 3 feet; not suitable for gravel.	Fair to good; sand at a depth of 3 feet.	Slopes erode easily; resistance to shearing in foundations to a depth of 36 inches may be low. Fair suitability.	----------------
Hecla-Hamar (HH)	Slightly susceptible.	Fair to a depth of 9 to 12 inches.	Some areas may be suitable for sand and gravel.	Fair to good; sand or gravel in substratum.	Fluctuating water table. Fair suitability.	Permeability may be excessive. Poor to fair suitability.
Hidewood (Hw, Hy).	Moderately to highly susceptible.	Fair to a depth of 15 inches.	Not suitable	Fair to poor; high content of moisture.	Water table may be high; subject to flooding. Fair suitability.	Content of moisture and organic matter high. Fair suitability.
Kranzburg (KrA, KrB, KrC2).	Medium to high.	Good to a depth of 10 inches.	Not suitable	Fair to good; till at a depth of 50 inches.	Slopes erode easily; resistance to shearing in foundation may be low when soil is saturated. Fair suitability.	----------------
Lamoure (La)	Medium	Fair to good to a depth of 7 to 15 inches.	Not suitable	Poor to fair; high content of moisture.	Water table at a depth of about 3 feet; subject to flooding. Poor to fair suitability.	Loamy upper layers fair; underlying sand and gravel poor.
La Prairie (Lp, Ls)	Medium to high.	Good to a depth of 12 inches.	Not suitable	Fair; may have high content of moisture.	Water table at a depth of about 3 feet; subject to flooding. Poor to fair suitability.	May have high content of moisture. Poor to fair suitability.
Luton (Lu)	Medium to to high.	Fair to a depth of 12 inches.	Not suitable	Fair to poor; may have high content of moisture.	Subject to flooding. Fair suitability.	High content of moisture. Fair to poor suitability.
Maddock (MdB2, MdC2, MdD2).	Not susceptible.	Poor; material sandy.	Some areas may be suitable for sand; not suitable for gravel.	Good; steep slopes erode easily.	Sandy material Fair to good suitability.	----------------

See footnote at end of table.

interpretations of soils—Continued

built on soil or that practice is not applied]

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Substratum permeable. Poor suitability.	Fairly stable, pervious sand.	----------	Moderately rapid permeability; unfavorable topography in some places.	Highly erosive; level terraces needed.	Highly erosive soil.
Shallow to permeable sand and gravel. Poor suitability.	Fairly stable; 28 to 50 inches to sand and gravel.	----------	Moderately rapid permeability. Good suitability where topography permits irrigation.	Generally not needed on nearly level areas; slopes of 3 or 4 percent are erosive.	Slopes are erosive.
Permeable sand substratum.	Fairly stable; sand at 36 inches.	----------	Good permeability; flatter slopes fairly suitable.	Erosive soil; level or gradient terraces can be used.	Highly erosive soil.
Permeable sand and gravel substratum. Good suitability for dugout ponds.	Fairly stable; sand and gravel in substrata.	Swales and depressions may need drainage.	Fluctuating high water table.	----------	
Seams of sand at boundary between soil and glacial till in some places.	Resistance to shearing may be low when soil is saturated; fair suitability.	Slow permeability; ditches or tile needed in most places.	Permeability slow; drainage needed.	Run-in water; diversions may be needed.	
Seams of sand at boundary between soil and glacial till in some places	Slopes erode easily; resistance to shearing may be low. Fair suitability.	----------	Poor internal drainage caused by glacial till.	Moderately slow permeability of subsoil; gradient terraces are needed.	Erosive soil.
Fluctuating water table. Poor suitability except for dugout ponds.	Fairly stable material with high content of moisture.	Subject to flooding; surface drainage may be needed.	Poor drainage; ditches, tile, or bedding generally needed.	----------	
Sand layers may cause seepage. Poor to fair suitability.	Fairly stable material that may have high content of moisture.	Subject to flooding; depressions may need surface drainage.	Moderately permeable; high water table in some areas.	Water runs in occasionally; diversions may be needed.	
Sand layers may cause seepage. Poor to fair suitability.	Control of moisture difficult; saturated soil may have low resistance to shearing. Poor to fair suitability.	Slow permeability; poor surface drainage.	Subject to flooding	----------	
Pervious and may cause seepage. Poor suitability.	Pervious sand; slopes erode easily. Fair suitability.	----------	Moderately rapid permeability; low water-holding capacity.	Erosive soil; level or gradient terraces can be used.	Erosive soil.

See footnote at end of table.

TABLE 4.—*Engineering*

[Dashed lines indicate that structure is not

Soil series and map symbol [1]	Susceptibility to frost action	Suitability as source of—			Soil features affecting—	
		Topsoil	Sand and gravel	Road fill	Highway location	Dikes or levees
Moody (MsA, MoA, MoB).	Medium to high.	Good to a depth of 12 inches.	Not suitable	Fair; steep slopes erode easily.	Quartzite substratum in some places; fair to good suitability.	----------
Nora (NCC2, NCD2)	Medium	Good to a depth of 6 inches.	Not suitable	Fair; steep side slopes erode easily, and embankments may slough.	Slopes may erode. Fair to good suitability.	----------
Parnell (Pa)	Medium to high.	Fair to a depth of 9 inches.	Not suitable	Poor; high content of moisture. Plastic clays.	Ponding in some places. Poor to fair suitability. Plastic clays.	----------
Rauville (Ra)	Medium to high.	Poor; clayey and wet.	Not suitable	Poor; high content of moisture. Plastic clays.	Water table at a depth of 3 feet; subject to flooding for long periods. Poor suitability. Plastic clays.	High content of moisture. Poor suitability.
Rock land (Ro)	Not susceptible.	Not suitable; quartzite.	Not suitable	Poor to good; quartzite outcrop.	Quartzite bedrock at a depth of about 3 feet; some areas are rock cliffs. Poor to good suitability.	----------
Sinai (SnA, SnB)	Medium to high.	Fair to a depth of 8 inches.	Not suitable	Fair; resistance to shearing may be low when the soil is saturated.	May slough. Fair suitability.	----------
Sioux (BS)	Not susceptible.	Not suitable	Some areas may be suitable for gravel; not suitable for sand.	Good; gravel at a depth of about 8 inches.	Steep and shallow to gravel. Fair to good suitability.	----------
Terrace escarpments (Te).	Not susceptible.	Not suitable	Suitability unknown.	Variable; generally good.	Steep, variable soils. Poor to fair suitability.	----------
Trent (Tr)	Medium	Good to a depth of 14 inches.	Not suitable	Fair; resistance to shearing may be low when the soil is saturated.	No significant features that affect highway location.	----------
Vienna (VnA, VnB, VnC, VnC2).	Medium	Good to a depth of 8 inches.	Not suitable	Fair; embankments susceptible to erosion.	No significant features that affect highway location.	----------
Fordville (WeA, WeB).	Slight to medium.	Good to a depth of 8 inches.	Some areas may be suitable for sand and gravel.	Good; sand and gravel at about 30 inches.	No significant features that affect highway location.	Sand and gravel at a depth of 30 inches. Fair to good suitability.

[1] Soil complexes not listed. For their suitability and features refer to the soils in the complexes.

interpretations of soils—Continued

built on soil or that practice is not applied]

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Quartzite substratum. Not suitable in most places.	Resistance to shearing may be low when soil is saturated. Fair suitability.	----------	Shallow to quartzite substratum in some areas, but other areas moderately permeable and are suitable.	Gentle slopes erode easily.	Not needed on moderately shallow soil; deeper soils are highly erosive.
Poor to fair soil material.	Resistance to shearing may be low when soil is saturated. Fair suitability.	----------	Moderate permeability; steep slopes.	Erosive soil; level or gradient terraces can be used.	Highly erosive soil; maintenance essential.
Poor to good soil material.	High content of moisture. Fair suitability.	Depressions and potholes may need drainage.	----------	Water runs in frequently; diversions may be needed.	
High water table----	High content of moisture. Poor suitability.	Flooded for long periods; depressions may need surface drainage.	----------	----------	
----------	----------	----------	----------	----------	
----------	Fair to poor material----	----------	Slow permeability---	Slow permeability; gradient terraces needed on more sloping areas.	Erosive soil.
Pervious gravel causes seepage. Poor suitability.	Excess gravel may cause seepage; poor suitability.	----------	Rapid permeability; low water-holding capacity.	----------	
Pervious layers may cause seepage. Poor suitability.	Gravel and sand may cause seepage. Poor suitability.	----------	Rapid permeability; steep slopes.	Very shallow, porous soils.	
Fair to good soil material.	Resistance to shearing may be low when soil is saturated. Fair suitability.	----------	May need internal drainage.	----------	Fairly stable soil.
Fair to good soil material.	Slopes erode easily. Fair suitability.	----------	Glacial till underlying material; most areas are too sloping. Not suitable.	Erosive soil; terraces needed on sloping areas.	Erosive soil; maintenance important.
Pervious sand and gravel may cause seepage. Poor suitability.	Sand and gravel may cause seepage. Fair to good suitability.	Good internal drainage.	Fair to good water-holding capacity; thin surface layer.	Shallow to coarse materials.	Shallow to sand or gravel.

TABLE 5.—*Engineering test data [1] for soil samples taken from five soil profiles*

Soil name and location	Parent material	Depth	Horizon	Mechanical analysis [2]: Percentage passing sieve—: ⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Percentage smaller than 0.005 mm.	Liquid limit	Plasticity index
		Inches									
Benclare silty clay loam: ⅒ mile E. and 80 feet N. of SW. cor., sec. 6, T. 101 N., R. 47 W.	Old terrace.	0–7	A1p			100	99	96	43	51	2
		7–12	B21			100	99	96	42	56	2
		12–19	B22			100	99	96	46	56	3
		19–25	B23			100	99	96	46	45	2
		25–31	B21ca			100	98	94	50	49	2
		31–37	B22ca			100	99	94	59	55	3
		37–45	D–B23ca				100	98	76	63	3
		45–54	D–B24ca				100	96	77	71	4
		54–62	D–B25ca				100	99	86	78	5
La Prairie silt loam: 320 feet W. and 55 feet S. of Beaver Creek bridge, sec. 15, T. 101 N., R. 48 W.	Alluvium.	0–8	A1p			100	99	82	24	38	1
		8–16	B1			100	98	76	22	38	1
		16–23	B21			100	99	78	23	36	1
		23–29	B22			100	99	76	22	36	1
		29–36	B23			100	99	78	21	32	1
		36–42	B24			100	98	83	18	30	1
		42–47	B31			100	95	55	15	22	[illegible]
		47–52	C			100	94	43	6	21	[illegible]
		52–59	Cgca			100	99	55	16	25	1
		59–67	Cgca(A1b)				100	75	24	32	1
Nora silt loam: 400 feet N. and 85 feet E. of SW. cor., sec. 5, T. 102 N., R. 48 W.	Wisconsin loess.	0–5	ABp				100	98	27	45	2
		5–12	B21	100	98	98	98	96	30	40	1
		12–18	B22				100	98	28	41	1
		18–24	B23ca		100	99	98	95	25	35	1
		24–31	B24ca	100	99	98	97	93	24	34	1
		31–38	B25ca	100	99	98	97	94	22	31	1
		38–45	B31ca			100	99	96	22	33	1
		45–55	B32ca				100	97	22	31	[illegible]
		55–67	Cca				100	98	19	30	[illegible]

Egeland loam: 510 feet W. and 30 feet S. of NE. cor., sec. 16, T. 102 N., R. 49 W.	Eolian outwash sands over outwash gravel.	0–4	A11p	------	------	100	83	58	16	32	11
		4–9½	A12p	------	------	100	80	56	16	34	10
		9½–15	B1	------	------	100	81	54	18	34	14
		15–19	B21	------	------	100	77	46	16	27	8
		19–26	B22	------	100	99	62	27	9	22	7
		26–33	B31	------	100	97	47	15	3	19	4
		33–38	B32	------	100	97	50	15	3	18	2
		38–52	C1ca	------	100	96	50	14	3	16	2
		52–67	C2ca	100	99	93	36	8	2	16	1
Trent silty clay loam: ¼ mile W. of E. ¼ cor., sec. 7, T. 104 N., R. 48 W.	Wisconsin loess.	0–8	A1p	------	------	------	100	98	27	49	26
		8–14	A1	------	------	------	100	98	35	48	18
		14–20	B1	------	------	------	100	98	37	48	24
		20–26	B21	------	------	------	100	99	36	51	28
		26–31	B22	------	------	------	100	99	36	48	26
		31–39	B23	------	------	------	100	99	37	44	23
		39–47	B31ca	------	100	99	99	97	21	31	8
		47–53	B32ca	------	------	100	99	97	24	34	12
		53–60	Cgca	------	------	------	100	98	19	32	10

[1] Tests performed by the South Dakota Department of Highways in cooperation with U.S. Department of Commerce, Bureau of Public Roads, according to standard procedures of the American Association of State Highway Officials (AASHO).

[2] Mechanical analyses according to the AASHO Designation: T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diame lations of grain-size fractions. The mechanical analy not suitable for use in naming textural classes for

[3] Based on Standard Specifications for Highway Sampling and Testing (Pt. 1, Ed. 8): The Classificati gate Mixtures for Highway Construction Purpose M 145–49.

[4] Based on the Unified Soil Classification System No. 3–357, v. 1, Waterways Experiment Station, C 1953.

TABLE 6.—*Engineering test data* [1] *for soil*

[Dashed lines indicate that soils were not

Soils and map symbols	Horizon	Number of samples tested	Mechanical analysis: Percent passing sieve—No. 10 (2.0 mm.) Range	No. 10 Mean	No. 40 (0.42 mm.) Range	No. 40 Mean	No. 200 (0.074 mm.) Range	No. 200 Mean
Alcester silt loam (AcA, AcB).	A	8	98–100	99	87–99	95	64–98	86
	B	11	96–100	99	89–99	95	71–94	84
	C	4	98–100	99	91–100	97	69–99	89
Benclare silty clay loam (Bc, Bd).	AB	1	100	100	100	100	99	99
Brookings silt loam (Be).	AB	2	91–99	95	72–94	83	51–85	68
	C	2	95–100	97	88–96	92	69–89	79
Buse loam (BmD, BnE, BoD).	A	2	93–98	96	86–87	87	58	58
	C	4	97–100	98	90–99	93	68–98	80
	C_{ca}	4	98–99	98	91–94	92	69–83	75
Crofton silt loam (CrC2, CrD2, CrE).	C	1	100	100	100	100	99	99
Egeland loam (EgA, EgB, EgC2).	A	11	99–100	100	77–98	90	28–80	56
	B	6	97–100	99	87–98	92	39–79	69
	C	6	99–100	100	76–99	88	10–84	42
	D	2	96–100	98	59–92	76	11–16	14
Estelline silt loam (EsA, EsB).	A	20	92–100	99	76–99	93	49–97	77
	B	20	83–100	98	60–100	94	25–97	71
	C	6	71–100	94	65–100	83	19–96	53
	D	10	46–100	80	15–64	42	2–17	10
Flandreau loam (FaA, FaB, FaB2, FaC2).	A	4	99–100	100	84–94	90	60–74	67
	B	5	91–100	98	78–94	88	38–78	61
	D	3	88–100	96	63–71	67	17–42	29
Hidewood silty clay loam (Hw, Hy).	A	1	99	99	96	96	90	90
	C	1	99	99	96	96	90	90
Kranzburg silty clay loam (KrA).	A	19	95–100	98	86–99	94	59–96	81
	B	29	92–100	98	75–100	93	45–99	80
	C	27	80–100	98	67–100	93	50–99	82
Kranzburg silty clay loam (KrB, KrC2).	A	1	100	100	97	97	86	86
	B	2	99–100	100	93–94	94	75–82	78
	C	1	99	99	93	93	75	75
La Prairie silt loam (Ls).	A	10	97–100	100	87–100	97	61–96	84
	B	14	94–100	99	70–100	90	24–97	68
	C	2	89	89	33–56	45	6–37	22
Luton clay (Lu).	A	20	98–100	100	87–99	95	58–97	82
	AC	15	97–100	99	79–99	92	40–97	73
	C	4	98–100	99	92–99	95	31–95	74
	D	6	76–99	88	28–94	54	6–17	9
Maddock loamy fine sand (MdB2, MdC2, MdD2).	A	5	96–100	99	82–94	85	3–89	48
	AC	6	96–100	99	84–95	88	26–81	57
	C	4	87–100	94	55–87	66	6–25	16
Moody silty clay loam (MsA).	AB	1	100	100	100	100	95	95
	BC	1	100	100	100	100	94	94

See footnotes at end of table.

samples taken along proposed highway routes

tested for property; NP stands for nonplastic]

Mechanical analysis—Con.		Liquid limit		Plasticity index		Maximum density [2]		Optimum moisture [2]		Classification	
Percent smaller than 0.005 mm.										AASHO	Unified
Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean		
						Lb. per cu. ft.	*Lb. per cu. ft.*	*Percent*	*Percent*		
12–43	29	37–51	42	11–27	18	------	------	------	------	A-7-6(11)	CL.
20–51	28	32–58	41	11–34	19	------	------	------	------	A-7-6(12)	CL.
29–45	34	32–50	39	14–23	18	120	120	13	13	A-6(11)	CL.
55	55	62	62	41	41	------	------	------	------	A-7-6(20)	CH.
11–12	12	43	43	13–14	14	------	------	------	------	A-7-6(9)	ML.
18–31	25	32–38	35	11–21	16	------	------	------	------	A-6(10)	CL.
12–20	16	38–39	39	15–17	16	------	------	------	------	A-6(10)	CL.
20–34	26	34–41	36	11–19	16	115	115	14	14	A-6(11)	CL.
24–34	29	29–41	34	11–21	17	120	120	13	13	A-6(11)	CL.
27	27	35	35	15	15	------	------	------	------	A-6(10)	CL.
3–27	10	22–47	31	4–16	9	------	------	------	------	A-4(4)	ML–CL.
7–25	15	21–39	33	4–17	12	------	------	------	------	A-6(8)	CL.
3–17	10	NP–42	17	NP–20	8	------	------	------	------	A-4(1)	SC.
3	3	NP	NP	NP	NP	------	------	------	------	A-2-4(0)	SM.
8–40	19	27–64	40	7–39	16	------	------	------	------	A-6(10)	ML–CL.
5–50	23	20–57	38	2–34	18	------	------	------	------	A-6(10)	CL.
5–41	17	19–49	31	3–29	14	------	------	------	------	A-6(5)	CL.
0–9	3	NP–16	5	NP–1	NP	------	------	------	------	A-1-b(0)	SW–SM.
6–27	17	30–38	35	8–15	12	------	------	------	------	A-6(7)	ML–CL.
6–28	16	32–47	38	15–21	17	------	------	------	------	A-6(8)	CL.
2–20	12	23–31	27	7–17	12	------	------	------	------	A-2-6(0)	SC.
16	16	47	47	21	21	------	------	------	------	A-7-6(14)	ML–CL.
20	20	39	39	18	18	------	------	------	------	A-6(11)	CL.
8–26	15	35–57	47	11–21	15	------	------	------	------	A-7-5(12)	ML.
12–43	25	32–53	45	11–28	20	------	------	------	------	A-7-6(13)	ML–CL.
12–32	23	26–55	38	6–34	17	------	------	------	------	A-6(11)	CL.
12	12	49	49	11	11	------	------	------	------	A-7-5(11)	ML.
21–41	31	39–42	40	14–24	19	------	------	------	------	A-6(12)	CL.
41	41	42	42	24	24	------	------	------	------	A-7-6(14)	CL.
16–41	28	30–50	40	8–26	17	------	------	------	------	A-6(11)	CL.
11–41	25	21–54	37	7–25	17	------	------	------	------	A-6(10)	CL.
0–11	6	NP–33	16	NP–13	6	------	------	------	------	A-1-b(0)	SM–SC.
7–53	29	31–70	52	11–46	28	------	------	------	------	A-7-6(18)	CH.
14–61	27	20–70	38	5–46	19	------	------	------	------	A-6(11)	CL.
16–38	24	20–46	33	3–23	12	------	------	------	------	A-6(9)	CL.
1–4	2	NP–17	NP	NP–2	NP	------	------	------	------	A-3(0)	SW–SM.
2–40	17	24–49	36	5–28	14	------	------	------	------	A-6(4)	SC.
4–34	20	18–47	34	3–32	16	------	------	------	------	A-6(7)	CL.
1–11	5	15–20	17	1–6	3	119	119	10	10	A-2-4(0)	SM.
------	------	44	44	13	13	------	------	------	------	A-7-5(10)	ML.
------	------	39	39	16	16	------	------	------	------	A-6(10)	CL.

See footnotes at end of table.

TABLE 6.—*Engineering test data*[1] *for soil samples*

[Dashed lines indicate that soils were not

Soils and map symbols	Horizon	Number of samples tested	Mechanical analysis — Percent passing sieve— No. 10 (2.0 mm.) Range	No. 10 (2.0 mm.) Mean	No. 40 (0.42 mm.) Range	No. 40 (0.42 mm.) Mean	No. 200 (0.074 mm.) Range	No. 200 (0.074 mm.) Mean
Moody silty clay loam (MoA, MoB).	A	8	97–100	100	89–100	98	80–99	95
	B	13	95–100	99	89–100	98	78–99	95
	C	9	99–100	100	98–100	99	93–99	97
Moody-Nora silty clay loams (MNB, MNB2, MNC2).	A	22	98–100	100	97–100	99	86–99	95
	B	10	98–100	100	96–100	99	79–99	95
	C	25	96–100	100	84–100	98	38–99	87
Rauville silty clay loam (Ra).	AC	1	99	99	97	97	86	86
Sinai silty clay (SnA, SnB).	A	3	99–100	100	92–97	95	76–86	80
	B	5	91–100	98	89–99	95	79–86	83
	C	6	85–100	94	63–99	85	45–93	71
Terrace escarpments (Te).	A	1	66	66	25	25	6	6
	B	1	46	46	26	26	11	11
	D	2	69–91	80	25–60	43	5–16	11
Trent silty clay loam (Tr).	AB	1	100	100	99	99	91	91
Vienna silt loam (VnA, VnB, VnC, VnC2).	A	4	98–100	99	92–97	95	71–89	81
	B	6	99–100	99	92–100	95	69–94	79
	C	2	97–98	97	91	91	70–73	72
Fordville loam (WeA, WeB).	A	5	78–100	95	54–94	80	31–85	61
	B	3	97–100	99	87–98	93	66–94	76
	C	8	58–100	82	27–99	59	7–46	19

[1] Tests made by the South Dakota Department of Highways.

Table 5 lists the results of soil tests conducted on 5 soil profiles. These tests were performed by the South Dakota Department of Highways in cooperation with the Bureau of Public Roads. The tests were conducted according to standard AASHO procedures (*1*). The column heads in table 5 are self-explanatory or are discussed elsewhere in this subsection.

Table 6 summarizes the data obtained by the South Dakota Department of Highways in their program of soil exploration and soil testing. The samples were taken along proposed highway routes and were tested in the Department of Highways laboratories. The data from these tests, together with data on traffic intensity, precipitation, frost action, height of water table, and topography, are used to determine the total thickness of pavement that is necessary to support wheel loads adequately. At each sampling location the soil was identified in terms of a soil mapping unit of the soil survey. The range and mean value of the test results of all samples within each mapping unit were reported. For highway design purposes, the samples taken represent only major horizontal and vertical changes in soil texture and color. Therefore, more than one soil horizon may be represented in an engineering sample. The horizons listed in table 6 are the major horizons that the engineering samples are thought to represent.

The mechanical analysis and the tests to determine liquid limit, plasticity index, and dry loose weight were made on the number of samples listed for each horizon. These samples were tested for highway purposes. The data on optimum moisture and maximum density were obtained from fewer than the number of samples listed, generally only one or two.

The AASHO and Unified classifications in table 6 are based on the mean values listed in this table. They do not indicate the classification of any one sample or the range in classification of a particular horizon.

Properties of soils in soil associations

Discussed in the following paragraphs are the 10 soil associations in the county and the properties of their soils that are significant to engineering. To see the location

taken along proposed highway routes—Continued

tested for property; NP stands for nonplastic]

Mechanical analysis—Con.										Classification	
Percent smaller than 0.005 mm.		Liquid limit		Plasticity index		Maximum density [2]		Optimum moisture [2]		AASHO	Unified
Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean		
						Lb. per cu. ft.	*Lb. per cu. ft.*	*Percent*	*Percent*		
13–21	17	35–47	43	13–19	16	----------	----------	----------	----------	A-7-6(11)	ML-CL.
10–23	16	31–50	41	6–31	17	----------	----------	----------	----------	A-7-6(11)	ML-CL.
19–37	25	36–46	40	15–24	18	----------	----------	----------	----------	A-6(11)	CL.
10–37	23	35–56	43	6–26	16	----------	----------	----------	----------	A-7-6(11)	ML-CL.
20–37	28	28–47	42	9–26	17	----------	----------	----------	----------	A-7-6(11)	ML-CL.
9–38	24	19–48	35	2–27	13	104–120	109	14–19	18	A-6(9)	CL.
17	17	41	41	21	21	----------	----------	----------	----------	A-7-6(13)	CL.
12–19	16	44–55	49	14–27	20	----------	----------	----------	----------	A-7-6(14)	ML-CL.
18–26	22	47–55	51	17–28	22	----------	----------	----------	----------	A-7-6(15)	MH-CH.
21–32	26	34–45	41	5–23	17	----------	----------	----------	----------	A-7-6(10)	ML-CL.
1	1	NP	NP	NP	NP	----------	----------	----------	----------	A-1-b(0)	SW-SM.
4	4	22	22	6	6	----------	----------	----------	----------	A-1-a(0)	GM-GC.
1–2	2	16	16	2	2	----------	----------	----------	----------	A-1-b(0)	SW-SM.
15	15	48	48	19	19	----------	----------	----------	----------	A-7-6(14)	ML-CL.
10–56	36	44–56	49	13–36	25	105–112	109	15–19	17	A-7-6(16)	CL.
33–49	41	37–60	46	21–39	28	----------	----------	----------	----------	A-7-6(16)	CL.
27–44	36	34–43	39	15–21	18	105	105	18	18	A-6(11)	CL.
3–30	14	35–42	39	9–14	11	----------	----------	----------	----------	A-6(6)	ML.
26–31	29	35–44	40	16–26	19	----------	----------	----------	----------	A-6(11)	CL.
2–7	4	NP–29	7	NP–11	2	----------	----------	----------	----------	A-2-4(0)	SM.

[2] Data obtained from tests on fewer samples than the number listed.

of each association, refer to the General Soil Map.

Luton-Dimmick association.—Soils on flood plains make up most of this soil association. Much of the area is subject to flooding, and a high water table is common. Some of the soils in this association have a high shrink-swell potential.

Fordville-Estelline association.—Soils on terraces make up most of this association. These soils are medium textured and are erosive. Their surface layer is thin and is underlain by sand and gravel in most places. If a high embankment is built on these soils, they may slide at the contact with the underlying sand or gravel. Parts of the area, however, may be good sources of sand and gravel that are suitable for use in construction.

Benclare association.—This association is on stream terraces and is made up of fine-textured soils underlain by clayey alluvium. These soils are good for construction that requires impervious material, but precautions should be taken if high embankments are built on them, because their strength against shearing is low when they are saturated.

Moody-Trent association.—Soils on loessal uplands make up most of this association. Some parts of the area are underlain by quartzite bedrock. These silty soils have low strength against shearing when the content of moisture is high. They are somewhat erosive.

Nora-Moody association.—Medium-textured and moderately fine textured soils on loessal uplands make up most of this association. These soils are highly erosive. Their strength against shearing is low when they are saturated. Grassed waterways on these soils need to be maintained.

Egeland-Maddock association.—Coarse-textured soils on uplands and terraces make up most of this association. These soils are highly erosive. Some areas may be a good source of fine sand suitable for use in construction.

Vienna association.—Medium-textured soils that developed in glacial till on uplands make up most of this association. When these soils are saturated, their strength against shearing is fair. Maintenance is needed on grassed waterways.

Buse-Sioux association.—Thin, coarse-textured and

medium-textured soils on hilly uplands make up most of this association. The Sioux soils are underlain by gravel that may be suitable for use in construction. The Buse soils in the area are fairly impervious when compacted. Because the sloping Buse soils are erosive, structures on them need to be maintained.

Kranzburg-Parnell association.—Soils on uplands and in depressions and potholes make up most of this association. Ponding is common in the depressions and potholes. The shearing strength of these soils is low when the soils are saturated. Soils underlain by glacial till tend to slide at the contact with the till.

Rock land association.—In this association are shallow soils adjacent to rock outcrops, and soils in alluvium that are shallow to bedrock. The bedrock is within a depth of 3 feet in most places. Many large boulders and stones are on the surface. The soils are variable and are in loess, glacial till, and outwash sand and gravel.

Unusual areas that affect engineering

The soil data listed in the engineering tables indicate more or less normal conditions of a soil, a soil type, or a soil series. Some areas in the county, however, have unusual features that cannot be accounted for in the tables but that affect construction and engineering practices.

When the Big Sioux River overflows after a heavy rain falls upstream or locally, flooding changes the soil along the river by depositing or removing sediments. The shift in sediments may be as great a change as that from sand to clay.

In the northeastern part of the county, the underlying Sioux quartzite rises to the surface and crops out in spots as it extends from Garretson to Dell Rapids. This rise tends to block underground drainage in a broad area that is north of the rise and along the west branch of Pipestone Creek in Logan Township. In this area, the water table is within 5 feet of the surface in spring, but it usually falls to a depth of more than 5 feet by autumn.

Pockets and lenses of silt, sand, and gravel occur in the western part of the county in areas of Kranzburg, Sinai, and Buse soils. Areas of these pockets and lenses are generally too small to map separately, but they are important to the engineer who plans or builds structures.

In loessal areas the loess is generally 4 to 10 feet thick over glacial till. If cuts are to be made through the loess into the till, the area should be explored. In some places outwash sand and gravel occur between the loess and the glacial till. This sand and gravel ranges from a few inches to several feet in thickness.

Where a terrace is constructed in loessal areas, a seep may occur below the terrace. The seep is caused by water infiltrating down to the finer textured till and there building up until the pressure is great enough to force water to the surface in places below the terrace.

On some of the breaks, old glacial till crops out. These breaks can be recognized by the stones and boulders on them or by a distinct knoll or ridge. The soil material at the break differs greatly from that nearby, and may affect structures or engineering practices.

Formation and Classification of Soils

This section consists of five main parts. The first part tells how the soils of Minnehaha County were formed. The second part describes some of the important processes that affect the formation of horizons. In the third part the soil series are placed in great soil groups according to important differentiating characteristics. The fourth part technically describes each series and includes a description of a profile representative of the series. In the fifth part is a table that lists the results of chemical and a mechanical analyses of selected soils.

Factors of Soil Formation

Several factors have influenced the formation of soils in Minnehaha County. These factors are (1) parent material, (2) length of time the soils have been developing, (3) climate, (4) vegetation and other living organisms, and (5) relief and drainage.

Parent material

The soils of Minnehaha County developed in loess, in glacial till, and in alluvium, or water-laid deposits. In this report the subsection "Geology, Relief, and Drainage" gives additional information about the material in which the soils of the county developed.

Loess.—Loess is silty material deposited by wind. It is thin in the western third of the county and thick in the eastern two-thirds. The western boundary of this material runs from the northern boundary of the county along Skunk Creek to the Big Sioux River, and then parallels the Big Sioux River to the southern boundary of the county. The loess generally ranges from 2 to 10 feet in thickness, but in places it is more than 40 feet thick. This loess is thought to be derived from outwash in the Big Sioux River valley. A pebbly layer generally is between the loess and the underlying glacial till. Developed in the loess are moderately fine textured and medium-textured soils of the Moody, Nora, Crofton, Trent, and Flandreau series. The upper layers of Kranzburg soils developed in loess, but the lower subsoil developed in glacial till. Silty loess, or material of loess origin, is in the western third of the county. Pebbles and stones are on the surface of this material and in the profile. Kranzburg soils are the main soils in this silty area. Brookings soils occur in the moderately well drained areas.

A few areas of wind-deposited or reworked outwash sand occur on terraces and uplands along the eastern side of the Big Sioux River and along Skunk Creek. The Maddock, Egeland, and Athelwold soils formed in this sand. The Egeland and Athelwold soils are finer textured in the surface layer and subsoil than the Maddock soils.

Glacial till.—Several glaciers have moved across the county and have deposited a heterogeneous mixture of clay, silt, sand, gravel, and a few boulders. This mixture is called glacial till. Vienna soils developed in the nearly level to moderately sloping areas of glacial till, and the Buse soils developed on the steeper areas. Vienna soils generally have a silt loam surface layer.

The B and C horizons of Vienna soils are predominantly clay loam. The parent material is calcareous. The Buse soils are calcareous at or near the surface.

In the western part of the county silty material mantles an older, firm glacial till. The Beadle soils developed in places where erosion has removed the silty material or where silty material was not deposited. These soils occur with the Kranzburg soils. The Beadle soils have moderate, medium, prismatic structure in the upper part of the B horizon and moderate, strong, coarse, prismatic structure in the calcareous lower part. The texture above the glacial till ranges from silty clay loam to silty clay, but the till is a firm clay loam. Many soft white-eyes, or calcium carbonate accumulations, occur in the lower part of the B horizon and in the C horizon. In some areas these accumulations are 1 or 2 inches in diameter, but smaller accumulations also occur.

Water-laid deposits.—These deposits are extensive along the Big Sioux River and its main tributaries. The silty soils that formed in these deposits are in the La Prairie and the Estelline series. Buried profiles are in the La Prairie soils. Soils of the Hecla-Hamar complex formed in the sandy deposits. The fine-textured soils occur mostly on the bottom land of the Big Sioux River. The Lamoure and the Luton soils are somewhat poorly drained; the Dimmick soil is poorly drained; and the Rauville soil is very poorly drained. Older soils formed in water-laid deposits are in the Benclare and Corson series. These soils developed in loess or in alluvial sediments over clayey alluvium.

Recent alluvium that has been deposited in upland drainageways, in narrow valleys, and in swales is of local origin and is called Alluvial land. In a small area along Split Rock Creek, a rocky phase of Alluvial land occurs in areas where stones and boulders are scattered over the flood plain. The Hidewood and the Parnell soils formed in some of the swales and depressions of the uplands where local sediments were deposited. These soils are somewhat poorly drained to poorly drained, but Hidewood soils are better drained than the Parnell.

On high terraces finer textured soils are underlain by stratified sand and gravel. Sand or gravel is at a depth of 0 to 10 inches in Sioux soils, 10 to 36 inches in Fordville soils, and 36 to 60 inches in Estelline soils.

Terrace escarpments range from fine-textured to coarse-textured, older materials deposited by water, or are remnants of soils formed in glacial till.

Time

The length of time a soil material has been exposed to the effects of climate and vegetation is reflected in the soil. Generally, the longer the parent material has remained in place, the more fully developed are the horizons in the soil profile. Because of differences in parent material, relief, and climate, however, some soils develop more slowly than do others. Alluvial and colluvial soils are less developed than older soils because new parent materials are deposited periodically. Also, soils on steep slopes are likely to be less developed than soils on gentle slopes. On the steep slopes erosion removes the soil, and water runs off instead of entering the soil. Time, therefore, has little effect on soil development in such places. The development of Buse and Crofton soils has been affected little by time.

Time, along with the climate and vegetation, has been important in the development of the Moody, Kranzburg, Vienna, and Beadle soils. The Beadle soils developed in the oldest glacial till; the Vienna soils developed in the next oldest glacial till; and the Moody and Kranzburg soils developed in younger material that mantles the till.

Soils developed in water-laid deposits can be of different ages. The Corson and Benclare soils on high terraces or low uplands are possibly the oldest. Their A and B horizons little resemble the underlying clayey alluvium.

Climate

The climate of Minnehaha County is important in the formation of soils. The county has a typical continental climate that is characterized by wide seasonal variations. A subsection on climate in the section "General Nature of the County" gives additional information.

Areas of soil in this climate produce short, mid, and tall prairie grasses. Because rainfall is not heavy enough to leach the soils deeply, leaching normally does not extend below a depth of 2 or 3 feet. Some colloids have been translocated, but translocation is not extensive. Directly and indirectly, climate causes variations in plant and animal life and thus affects the formation of soils.

Moody, Kranzburg, Vienna, and other well-developed soils in the county have a dark-colored, granular surface layer, about 4 to 10 inches thick, and a lower subsoil containing free lime carbonates. These soils developed under native grass vegetation which, along with climate, has been a dominant factor in their formation.

Plant and animal life

Higher plants, micro-organisms, earthworms, and other forms of plant and animal life that live on and in the soil contribute to its morphology. They bring about changes in soil that depend on the kinds of life and life processes peculiar to each kind. The kinds of plants and animals that live on or in the soil are determined by climate, parent material, relief, age of the soil, and other factors of environment.

The native vegetation on the well-drained, well-developed soils in Minnehaha County was dominantly tall, mid, and short grasses. The soils, however, have few marked differences in morphology that result from the effects of vegetation. The density and kind of plants varied because of relief. Because runoff increases as slope increases in steepness, less water is available for plants, and they are less dense and of fewer kinds. The Buse soils formed on steep slopes. Because more water percolated into the soils on nearly level slopes, thicker soil horizons formed and the vegetation was more dense. The Moody, the Kranzburg, and the Vienna soils developed on such nearly level slopes.

Water-loving plants grew where water from higher soils ran onto lower soils in depressions and on level areas that had no surface drainage and slow internal drainage. In depressions where ponding occurred, micro-organisms and plant roots soon used up available

oxygen and reduction and other chemical changes took place.

The chemicals produced in reduction and other changes tend to reduce the number of bacteria in the soil and to restrict the deep growth of plant roots. When the number of micro-organisms has been reduced, decomposition is slowed and organic matter accumulates in the surface horizon. Furthermore, ponding prevents the products of weathering and of soil formation from being removed. As a result, gleying occurs, as has happened in the Parnell, the Dimmick, and similar soils. Generally, these soils are low in phosphorus.

The black, humic surface horizon and the light-gray gleyed horizon give these soils a distinct color profile. In most places the gleyed horizon is mottled with yellow flecks of ferric hydroxide. This mottling indicates that some oxidation still occurs. On the somewhat poorly drained soils the vegetation was a mixture of marsh plants and cordgrasses. Thus, gleying continued, but to a milder degree, as in the Luton soils.

Man has had only a minor influence on soil development. He has removed the native vegetation from the soil and pulverized the surface layer through plowing and cultivation. He has used inadequate cropping sequences and failed to control runoff. Consequently, many sloping fields have lost from 25 to 75 percent of their original surface soil through accelerated erosion. Although the loss of soil through erosion is a minor influence on soil development, it is a great influence on the potential of the soil to support plants and animals.

Relief and drainage

The relief, or lay of the land, in Minnehaha County dominates over the influence of climate and vegetation in the development of soils. On steep or hilly soils, runoff is rapid and water percolates slowly through the soil. Percolation is rapid through coarse materials of the more level areas. Under either condition, plant growth is restricted, the accumulation of organic matter is slight, and a thin soil develops. Examples are the Sioux soils, developed in coarse material on morainic terraces; the Buse soils, developed in glacial till on hillsides; the Maddock soils, developed in sandy materials; and the Crofton soils, developed in silty, wind-deposited materials.

Soils with the most development have formed in nearly level to gently rolling relief where runoff is ample but not excessive and percolation is good. Examples are the Moody and Nora soils, developed in loess; and the Vienna soils, developed in glacial till.

Other areas that show little soil development are flats where surface drainage is restricted and water intake is slow. In these areas the Dimmick and the Luton soils formed on the level bottom lands.

Formation of Horizons

Several processes take place in the formation of soil horizons. The main processes are (1) the accumulation of organic matter, (2) the leaching of calcium carbonates and bases, (3) the reduction and transfer of iron, and (4) the formation and translocation of silicate clay minerals. In most soils in the county, two or more of these processes have been active in the formation of horizons.

The soils of Minnehaha County range from high to very low in content of organic matter. The Trent soils, which are on uplands, have a thick, dark-colored A1 horizon that is high in organic-matter content. Crofton and Buse soils and other sandy soils on uplands have a thin A1 horizon that is low in organic-matter content. Carbonates and bases have been leached from many of the soils. However, the depth to free calcium carbonates ranges from 16 to 48 inches in the moderately well drained and the well drained soils. The A horizon ranges from medium acid to neutral, and the lower part of the B horizon is generally mildly alkaline or moderately alkaline.

Reduction and transfer of iron, a process called gleying, is evident in the horizons in poorly drained and very poorly drained soils. Examples are the mottled horizons of the Rauville, Dimmick, and Luton soils.

Translocation of silicate clay minerals has contributed to horizon development of nearly all soils except those in recent alluvium. The B horizon of most soils shows some accumulation of clay, which is indicated by clay films in pores and on the ped faces. The A horizon shows a loss of clay.

Classification of Soil Series in Great Soil Groups

The soil series has been defined in the section "How Soils Are Named, Mapped, and Classified." A great soil group consists of those soil series that have similar fundamental characteristics. In Minnehaha County the soil series belong to four great soil groups, as follows:

Chernozem—
- Alcester, Athelwold, Beadle, Benclare, Brookings, Corson, Egeland, Estelline, Flandreau, Fordville, Kranzburg, Moody, Nora, Sinai, Trent, and Vienna.

Humic Gley—
- Dimmick, Hamar, Hidewood, Lamoure, Luton, Parnell, and Rauville.

Regosol—
- Buse, Crofton, Hecla, Maddock, and Sioux.

Alluvial—
- La Prairie.

Chernozem soils have developed under grass vegetation. They are zonal soils with a moderately thick to thick, dark-gray (10YR 4/1), dark grayish-brown (10YR 4/2), to black (10YR 2/1) A1 horizon that is high to moderately high in organic-matter content in undisturbed areas. The content of organic matter decreases with increasing depth. Some clay has accumulated in the B horizon. In most profiles calcium carbonate has accumulated in the lower part of the subsoil. The pH is lowest in the surface layer and increases with increasing depth.

The Humic Gley soils have developed under grass in poorly drained areas. They are intrazonal soils with a thick, dark-gray (10YR 4/2) to black (10YR 2/1) A1 horizon. The subsoil is gray and may contain more clay than the A horizon. Strong, coarse and medium prisms in the subsoil break to strong, fine, angular and subangular blocks. The Parnell soils appears to be transitional toward the Soloth great soil group. The Dimmick soils are typical of the Humic Gley group.

The Regosols are azonal soils and are lighter colored than the Chernozem soils. Regosols developed in unconsolidated deposits of glacial till, loess, sand, and gravel and do not have well-defined genetic horizons. The Buse and the Crofton soils in this county have a weakly developed subsoil and intergrade toward the Chernozem great soil group. The Hecla, Maddock, and Sioux soils are more typical of the Regosol great soil group.

The Alluvial great soil group consists of azonal soils that are developed in alluvium and have been transported and deposited recently. The only soil series in this group is the La Prairie. In Minnehaha County this soil has a weakly developed subsoil and intergrades toward the Chernozem great soil group.

Technical Descriptions of Soils

This subsection was prepared for those who need more technical information about the soils in the county than is given elsewhere in the report. Described in the subsection are each soil series in the county and the profile of a soil at a named location. The profile is representative of the series. A profile description is a record of what the soil scientist saw when he dug into the ground and studied the soil. Soil descriptions that are probably easier for the general reader to understand are given in the section "Descriptions of Soils." They contain some interpretative and other information that is not in this subsection.

Alcester series

Soils of the Alcester series are moderately well drained Chernozems that formed in colluvial and alluvial sediments. These soils occur in narrow ribbons or bands in upland valleys and on foot slopes adjacent to streams. The areas are small and are in the eastern two-thirds of the county. The slopes range from 1 to 5 percent.

Alcester soils have a thicker A horizon than the Moody soils and a B horizon of weaker structure. They are not so well drained as the Moody soils. The Alcester soils are coarser textured than Trent soils, which developed in loess.

Profile of Alcester silt loam 0.45 mile east and 115 feet south of the northwest corner of sec. 6, T. 102 N., R. 48 W.

Alp—0 to 8 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure that breaks to moderate, medium, granular structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A1—8 to 14 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; moderate, medium and fine, subangular blocky structure; slightly hard when dry, very friable when moist; many worm casts; gradual, irregular boundary.

B1—14 to 26 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, prismatic structure; hard when dry, friable when moist; many worm casts; thin, patchy clay films on vertical faces of peds: noncalcareous; gradual boundary.

B21—26 to 35 inches, yellowish-brown (10YR 5/4) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium and coarse, prismatic structure; hard when dry, friable when moist; many worm casts; thin, continuous clay films on ped faces; noncalcareous; gradual boundary.

B22—35 to 42 inches, light yellowish-brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) when moist; moderate, medium and coarse, prismatic structure; hard when dry, friable when moist; thin, patchy clay films on vertical faces of peds; clear, wavy boundary.

Cca—42 to 60 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, grayish brown (2.5Y 5/2) when moist; few, fine, faint, light-gray (2.5Y 7/2) and yellow (2.5Y 7/6) mottles; massive (structureless); very hard when dry, firm when moist, sticky when wet; common, fine and medium, soft concretions of calcium carbonate.

The A horizon ranges from 10 to 16 inches in thickness and from silt loam to silty clay loam in texture. The B horizon ranges from 20 to 30 inches in thickness. It contains more clay than the A horizon. It is silty clay loam in most places and is silt loam in some places. A lime zone is in the lower part of the B horizon in some areas. The material below 3 feet varies from silty loess to clay loam glacial till. It is stratified sand, silt, and gravel, in places, especially along the foot slopes of the larger streams.

Athelwold series

In the Athelwold series are moderately well drained Chernozems. These soils formed in silty calcareous loess that overlies eolian or outwash sand, or stratified sand and gravel. They are inextensive and occur in nearly level areas and in slight depressions on uplands or terraces. They are also at the head of some drainageways and at the base of some gentle slopes. The slopes range from 0 to 2 percent.

Athelwold soils have a thicker A horizon than have the Estelline, Flandreau, or Fordville soils and are not so well drained as those well-drained soils. Athelwold soils are coarser textured than Trent soils and have a sandy substratum that is lacking in the Trent soils.

Profile of Athelwold silt loam in a cultivated field, 310 feet east and 75 feet south of the northwest corner of sec. 28, T. 104 N., R. 47 W.

Alp—0 to 6 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure that breaks to weak, medium and fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A1—6 to 14 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure that breaks to weak, medium and fine, granular structure; soft when dry, very friable when moist; thin, patchy clay films on vertical faces of peds; noncalcareous; gradual, smooth boundary.

B1—14 to 24 inches, very dark grayish-brown (10YR 3/2) silt loam, black (10YR 2/1) when moist; few, fine, faint, grayish-brown (2.5Y 5/2) and light olive-brown (2.5Y 5/4) mottles; weak, medium and fine, prismatic structure; slightly hard when dry, very friable when moist; many worm casts; thin, patchy clay films on vertical faces of peds; noncalcareous; gradual, smooth boundary.

B21—24 to 32 inches, dark grayish-brown (2.5Y 4/2) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, faint, red (10R 4/6) mottles; weak, medium, prismatic structure and fine, subangular blocky structure; slightly hard when dry, very friable when moist; thin, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

B22—32 to 40 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, prominent, red (10R 4/6, 5/6) mottles; moderate,

medium, subangular blocky structure; slightly hard when dry, very friable when moist; thin, continuous clay films on ped faces; noncalcareous; abrupt, smooth boundary.

D1—40 to 48 inches, pale-yellow (2.5Y 7/4) fine sand, light olive brown (2.5Y 5/4) when moist; few, fine, prominent, red (10R 4/6, 5/6) mottles; single grain (structureless); noncalcareous; clear, wavy boundary.

Dca—48 to 60 inches, light-gray (2.5Y 7/2) and pale-yellow (2.5Y 7/4) fine sand, grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) when moist; many, medium and fine, distinct, dark reddish-brown (5YR 2/2) and reddish-yellow (7.5YR 7/8) mottles; calcareous.

The A horizon ranges from 10 to 16 inches in thickness. In a few places the texture is silty clay loam. The depth to sand ranges from 36 to 50 inches. Mottles in the lower part of the B horizon vary from few to many. Because the color of the mottles in the Dca horizon is distinct, it is hard to determine the true color of the matrix.

In some places, the D1 and Dca horizons are stratified mixed sand and gravel. In some places where the depth to sand is 50 inches or more, the lime zone is in the lower part of the B horizon. If the depth to sand is less than 50 inches, the lime zone is in the D horizon.

Beadle series

The Beadle series consists of well-drained, medium-textured and moderately fine textured soils of the Chernozem group. These soils developed in firm glacial till on upland slopes of 1 to 9 percent. They occur with the Kranzburg soils, mainly in the western part of the county.

The Beadle soils differ from Vienna soils in having stronger structure in their subsoil and larger white-eyes, or lime segregations. Beadle soils developed in glacial till whereas Kranzburg soils developed in loess or in silty drift that mantles glacial till.

Profile of Beadle silty clay loam in a cultivated field 300 feet east and 260 feet south of the west quarter corner of sec. 2, T. 108 N., R. 50 W.

Alp—0 to 7 inches, very dark grayish-brown (10YR 3/2) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B2—7 to 16 inches, grayish-brown (10YR 5/3) silty clay loam, dark gray (10YR 4/1) when moist; moderate, medium prisms that break to moderate, fine, subangular blocks; slightly hard when dry, friable when moist; thin, continuous clay films; noncalcareous; abrupt, smooth boundary.

B21ca—16 to 28 inches, light olive-brown (2.5Y 5/4) silty clay loam, grayish brown (2.5Y 5/2) when moist; many, fine, pale-yellow (2.5Y 7/4) and reddish-yellow (7.5YR 6/8) mottles; moderate, coarse prisms that break to moderate, medium, subangular blocks; hard when dry, friable when moist; thick, continuous clay films on ped faces; calcareous; many white-eyes, or lime segregations; clear, smooth boundary.

B22ca—28 to 42 inches, light olive-brown (2.5Y 5/4) silty clay, grayish brown (2.5Y 5/2) when moist; many, fine, reddish-yellow (7.5YR 6/8) and strong-brown (7.5YR 5/6) mottles; moderate and strong, coarse, prismatic structure; hard when dry, friable when moist; calcareous; many, medium, hard and soft concretions of lime; clear, smooth boundary.

C—42 to 60 inches, multicolored clay loam, light yellowish brown (2.5Y 6/4), pale brown (10YR 6/3), and pale yellow (2.5Y 7/4); massive (structureless); very hard when dry, firm when moist; calcareous; many, medium, hard and soft concretions of lime.

This soil occurs with Kranzburg soils and is not mapped separately. The A horizon and upper part of the B horizon are loesslike in some places. Generally, the B horizon is strongly developed, firm, clay loam glacial till. The depth to the lime zone ranges from 14 to 26 inches.

Benclare series

In the Benclare series are moderatly well drained to poorly drained Chernozems in fine-textured loess or in alluvium that abruptly overlies clay alluvium. These soils occur on level to gently sloping stream terraces. These terraces are high above present drainage channels, but broad swales in the terraces receive run-in water from adjacent uplands. The Benclare soils are mainly in the southeastern part of the county on the terraces along Beaver Valley Creek. The main part of this area is nearly level, but some parts are in depressions. Only a small acreage is on gentle slopes.

The Benclare soils have thicker A and B horizons than the Corson soils and are leached to a greater depth. They are nearly as fine textured as the Luton soils. Except on the poorly drained phase, Benclare soils have better surface drainage than Luton soils.

Profile of Benclare silty clay loam in a cultivated field 0.1 mile east of the southwest corner sec. 6 and 80 feet north of fence, T. 101 N., R. 47 W. (Laboratory No. 6211–6219).

Alp—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; very weak, coarse, prismatic structure that breaks to weak, fine, granular structure; hard to very hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B21—7 to 12 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; weak, coarse prisms that break to moderate, fine and very fine, subangular blocks; hard to very hard when dry, friable to firm when moist; thin, patchy clay films on vertical faces of the primary structural peds, and on the vertical and horizontal faces of the secondary peds; common pinholes and worm casts; noncalcareous; gradual, smooth boundary.

B22—12 to 19 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; weak, medium and coarse prisms that break to moderate to strong, fine and very fine, subangular blocks; very hard when dry, firm when moist; thin, patchy clay films on the vertical faces of the primary structural peds and thin, continuous clay films on the faces of the vertical and horizontal secondary peds; common pinholes and worm casts; noncalcareous; gradual, smooth boundary.

B23—19 to 25 inches, silty clay loam with no matrix color; weak, coarse and medium prisms that break to moderate to strong, fine and very fine, subangular blocks; very hard when dry, firm when moist; many worm casts and ped coats that are grayish brown (2.5Y 5/2) when dry and olive brown (2.5Y 4/4) when moist, or are very dark gray (10YR 3/1) when dry and black (10YR 2/1) when moist; thin, continuous and moderate, patchy clay films on the vertical and horizontal faces of peds; common pinholes; noncalcareous; clear, smooth boundary.

B21ca—25 to 31 inches, grayish-brown (2.5Y 5/2) silty clay loam, olive brown (2.5Y 4/4) when moist; weak, coarse and medium prisms that break to moderate to strong, fine and very fine, subangular blocks; very hard when dry, firm when moist; few to common, very dark gray (10YR 3/1) worm casts, black (10YR 2/1) when moist; thin, continuous or patchy clay films on the ped faces; common pinholes; weakly to moderately calcareous; few to common, small and medium, hard concretions of lime; gradual, smooth boundary.

B22ca—31 to 37 inches, light brownish-gray (2.5Y 6/2) silty clay, olive (5Y 4/3) when moist; few, medium, faint iron stains; moderate, coarse and very coarse prisms that break to moderate, fine and very fine, subangular blocks; very hard when dry, firm when moist; few black worm casts; common pinholes; thin, continuous or patchy clay films on the ped faces; moderately calcareous to strongly calcareous; clear, smooth boundary.

D–B23ca—37 to 45 inches, light-gray (5Y 6/1) clay, olive (5Y 4/3) when moist; common, medium, faint iron and manganese stains; moderate to strong, coarse and medium prisms that break to moderate and strong, medium and fine, angular blocks; extremely hard when dry, very firm when moist; thick, continuous clay films on ped faces that have patchy, black ped coats; moderately to strongly calcareous; common to many, medium, hard concretions of lime; gradual, smooth boundary.

D–B24ca—45 to 54 inches, light-gray (5Y 6/1) clay, olive (5Y 4/3) when moist; common, medium, very faint iron and manganese stains; moderate to strong, coarse and medium prisms that break to moderate and strong, medium and fine, angular blocks; extremely hard when dry, very firm when moist; thick, continuous clay films on ped faces that have patchy, black ped coats; common pinholes; moderately calcareous; few to common, medium, hard concretions of lime; gradual, smooth boundary.

D–B25ca—54 to 62 inches +, clay with no matrix color; light-gray (2.5Y 7/2), gray (N 5/0), pale-yellow (2.5Y 8/4), and light olive-brown (2.5Y 5/4) mottles when moist; moderate to strong, coarse and medium prisms that break to moderate to strong, medium and fine, angular blocks; extremely hard when dry, very firm when moist; thick, continuous clay films on vertical faces of peds; faces of horizontal peds have very thick, patchy clay films and slickensides; common pinholes; weakly to moderately calcareous.

The A horizon ranges from 6 to 14 inches in thickness but is silty clay loam of uniform texture. The B horizon ranges from 30 to 50 inches in thickness. Lime has accumulated at a depth of 24 to 40 inches. The underlying material is dense clay that has vertical seams of silt. A few small areas in swales and in slight depressions are somewhat poorly drained, but the larger areas in slight depressions are poorly drained.

Brookings series

In the Brookings series are moderately well drained Chernozems that formed in silty drift or loess that overlies a firm glacial till. These soils occur with the Kranzburg and Parnell soils in the western part of the county. Brookings soils are level and nearly level soils in slight depressions, in swales, and at the head of drains.

Brookings soils have thicker A and B horizons than have the Kranzburg soils but are not so well drained. They are better drained than Parnell soils.

Profile of Brookings silt loam in cultivated field 0.4 of a mile west and 450 feet south of the northeast corner of sec. 6, T. 104 N., R. 52 W.

A1p—0 to 7 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A1—7 to 14 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) when moist; weak, medium and coarse, subangular blocky structure that breaks to weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; gradual, wavy boundary.

B1—14 to 23 inches, dark grayish-brown (10YR 4/2) silty clay loam, black (10YR 2/1) when moist; few, fine, faint mottles that are light yellowish brown and olive brown; moderate, coarse prisms that break to medium and fine, subangular blocks; slightly hard when dry, friable when moist; noncalcareous; gradual, wavy boundary.

B2—23 to 29 inches, light olive-brown (2.5Y 5/4) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, faint, light yellowish-brown mottles; moderate, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; thick, continuous clay films; noncalcareous; gradual smooth boundary.

B3ca—29 to 45 inches, grayish-brown (2.5Y 5/2) silty clay loam, olive brown (2.5Y 4/4) when moist; few, fine, faint, yellowish mottles; moderate, coarse and medium prisms that break to weak, medium, subangular blocks; hard when dry, friable when moist; thick, patchy clay films; few, fine, hard and soft concretions of lime; calcareous; gradual, smooth boundary.

Cca—45 to 65 inches; light-gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; common, fine and medium, prominent, yellow mottles with a dark reddish-brown center; massive (structureless); hard when dry, friable when moist; few, fine, hard and soft concretions of lime; calcareous.

The A horizon ranges from 8 to 16 inches in thickness and from silt loam to silty clay loam in texture. Because they are in depressions, these soils receive sediments washed onto their surface from higher soils. The B horizon ranges from 24 to 40 inches in thickness. Mottling varies in contrast, size, and color. In most places the lime accumulations are at a depth of 16 inches or more, and in a few places they are deeper than 36 inches. The depth to the firm glacial till is more than 30 inches, in most places.

Buse series

In the Buse series are excessively drained Regosols that formed in calcareous glacial till on rolling and steep side slopes of drainageways, of moraines, and around potholes. These soils make up a fairly large total acreage and occur in nearly all parts of the county. Profile of Buse loam is shown in figure 3 in the section "Descriptions of Soils."

The Buse soils occur with the well-drained Kranzburg and the well-drained Vienna soils. They do not have a well-developed B horizon like that in those soils, and calcareous material is at a shallower depth.

Profile of steep Buse loam in native pasture 0.17 mile east and 0.22 mile north of the southwest corner of sec. 20, T. 102 N., R. 48 W.

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocks that break to granules; slightly hard when dry, friable when moist; worked by worms; calcareous; gradual, smooth boundary.

C—5 to 12 inches, light brownish-gray (10YR 6/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; weak, medium prisms that break to moderate, fine, subangular blocks; hard when dry, friable when moist; worked by worms; thin, patchy clay films; calcareous; gradual, smooth boundary.

C1ca—12 to 23 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse and medium prisms that break to moderate, medium and fine, subangular blocks; hard when dry, friable when moist; worked by worms; thin, patchy clay films; calcareous; clear, smooth boundary.

C2ca—23 to 36 inches, yellow (10YR 8/6) silty clay, olive yellow (2.5Y 6/6) when moist; massive (structureless); very hard when dry, firm when moist; calcareous; fine, hard and soft concretions; gradual, smooth boundary.

C3ca—36 to 60 inches, brownish-yellow and yellow (10YR 6/8, 10YR 7/8, 10YR 8/8) silty clay loam, olive yellow (2.5Y 6/8) when moist; massive (structureless); very hard when dry, firm when moist; strongly calcareous; fine, hard and soft, white (10YR 8/2) concretions.

The A horizon ranges from 2 to 6 inches in thickness and from dark grayish brown to very dark grayish brown in color. It is mainly loam or clay loam, and it developed in friable or firm glacial till. In the loessal area, silt loam occurs almost directly above the glacial till.

A small amount of clay has accumulated in the subsoil. The Cca horizon is slightly lighter colored than the C horizon.

The Cca horizon ranges from friable to firm glacial till. In some places in the western part of the county, the C horizon consists of stratified silt and clay with seams of sand and gravel, or is a cobbly layer above firm glacial till.

These soils are usually calcareous at or near the surface. Pebbles and stones are on the surface and in the profile, and they vary in size and number.

Corson series

The Corson series consists of deep, well-drained soils in the Chernozem group. These soils formed on uplands in clayey alluvium or fine-textured loess. They are nearly level to sloping and lie between the soils in loess on upper slopes and the soils in glacial till on lower slopes. They also occur on low ridges and hills where the loess has been removed by erosion. These soils are east of the Big Sioux River in small areas along the more dissected drainageways.

The Corson soils have lighter colored and thinner A and B horizons than have the Benclare soils. In most areas the lime zone is in the upper part of the B horizon in Corson soils, but leaching in Benclare soils is generally to a greater depth. Corson soils are well drained, whereas the Benclare soils are moderately well drained. Corson soils are finer textured than the Moody or the Crofton soils.

Profile of Corson silty clay in a cultivated field 0.25 of a mile south and 310 feet east of the northwest corner of sec. 14, T. 102 N., R. 48 W. (Laboratory No. 4686–4694).

A1p—0 to 5 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; moderate, medium and coarse, blocky structure that breaks to fine, granular structure; hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B21—5 to 9 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; weak, coarse, prismatic structure that breaks to moderate, fine and very fine, granular and subangular blocky structure; hard when dry, firm when moist; thin, continuous clay films; noncalcareous; clear, smooth boundary.

B22—9 to 14 inches, dark grayish-brown (2.5Y 4/2) silty clay, very dark brown (10YR 2/2) when moist; moderate, fine and very fine, subangular blocky structure; hard when dry, firm when moist; dark minerals; thin, continuous or patchy clay films; noncalcareous; clear, smooth boundary.

B23—14 to 19 inches, dark grayish-brown (2.5Y 4/2) silty clay, very dark brown (10YR 2/2) when moist; weak, fine and very fine, subangular blocky structure; very hard when dry, firm when moist; moderately thick, continuous and thick, patchy clay films; noncalcareous; clear, smooth boundary.

B24—19 to 24 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish-brown (2.5Y 3/1) when moist; moderate, coarse and medium prisms that break to moderate, fine and very fine, subangular blocks; very hard when dry, firm when moist; thin, continuous or patchy clay films; weakly calcareous; clear, smooth boundary.

B25ca—24 to 33 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse and medium prisms that break to moderate, fine and very fine, subangular blocks; hard when dry, firm when moist; thin, continuous and moderate, patchy clay films; dark minerals; calcareous; clear, smooth boundary.

B26ca—33 to 41 inches, light yellowish-brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) when moist; weak, coarse prisms that break to weak, medium blocks and these, in turn, break to weak, fine and very fine, subangular and angular blocks; hard when dry, firm when moist; dark minerals; thin, continuous clay films; calcareous; few, large concretions of lime; clear, wavy boundary.

B27ca—41 to 44 inches, light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) when moist; common, medium, distinct, light-gray (2.5Y 7/2) mottles; weak, coarse prisms that break to medium and fine blocks; hard when dry, firm when moist; thin, continuous and patchy clay films; faint iron stains; calcareous; few, large concretions of lime; clear, wavy boundary.

B28ca—44 to 60 inches, light brownish-gray (2.5Y 6/2) silty clay, olive brown (2.5Y 4/4) when moist; light-gray mottles (N 7/1), few iron stains; moderate, coarse amd medium prisms that break to strong, fine and very fine, angular blocks; very hard when dry, very firm when moist; continuous and thick, patchy clay films; calcareous; few, large concretions of lime.

The A horizon ranges from very dark gray to a dark grayish brown in color and from clay to silty clay in texture. The thickness of this horizon is 4 to 8 inches. In some areas loess recently has thinly capped these soils. The B horizon ranges from silty clay to clay, and the lime zone is below a depth of 11 inches in the most nearly level and the gently sloping areas. On some slopes of more than 7 percent the A horizon is calcareous.

Crofton series

In the Crofton series are excessively drained Regosols that developed in strongly calcareous, loessal uplands on slopes that range from 5 to 30 percent. These soils have a thin silty surface layer. They occur mainly on the steeper slopes of the eastern two-thirds of the county.

The Crofton soils have a thinner surface layer and a less developed profile than have the Moody and Nora soils. Lime is at the surface in the Crofton soils or is at a depth of less than 10 inches. The lime occurs at a

depth of more than 30 inches in the Moody soils, and at 10 to 30 inches in the Nora soils.

Profile of Crofton silt loam in a cultivated field 100 feet west and 145 feet north of the southeast corner of sec. 6, T. 101 N., R. 48 W. (Laboratory No. 4544–4551).

ACp—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; thin, patchy clay films; slightly calcareous; abrupt, smooth boundary.

C1ca—6 to 13 inches, grayish-brown (2.5Y 5/2) silt loam, olive brown (2.5Y 4/4) when moist; weak, coarse and medium, prismatic structure that breaks to weak, fine, granular and blocky structure; soft when dry, friable when moist; thin, patchy clay films; weakly calcareous; few, small, hard concretions of lime; gradual, smooth boundary.

C2ca—13 to 20 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; weak, coarse and medium, prismatic structure that breaks to weak, fine, granular and blocky structure; slightly hard when dry, friable when moist; thin, patchy clay films; strongly calcareous; common, medium and small, hard concretions of lime; gradual, smooth boundary.

C3ca—20 to 25 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, prominent, yellowish-brown (10YR 5/8) iron stains; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; thin, patchy clay films; strongly calcareous; many, medium and small, hard concretions of lime; clear, smooth boundary.

C4ca—25 to 30 inches, light yellowish-brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) when moist; common, medium, distinct, light olive-brown (2.5Y 5/4) mottles; weak, coarse, prismatic structure to massive (structureless); slightly hard when dry, friable when moist; thin, patchy clay films; strongly calcareous; common, small, hard concretions of lime; gradual, smooth boundary.

C5ca—30 to 40 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; weak, coarse, prismatic structure to massive (structureless); slightly hard when dry, friable when moist; thin, patchy clay films; strongly calcareous; few, medium and small, hard concretions of lime; gradual, smooth boundary.

C6ca—40 to 48 inches, light yellowish-brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) when moist; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; massive (structureless); soft when dry, friable when moist; strongly calcareous; few, small and medium, hard concretions of lime; clear, smooth boundary.

C7ca—48 to 60 inches, light yellowish-brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, distinct, light olive-brown (2.5Y 5/6) mottles; massive (structureless); slightly hard when dry, friable when moist; strongly calcareous; few, smooth and medium, hard concretions of lime.

The surface layer ranges from 2 to 6 inches in thickness and from very dark grayish brown to olive brown in color. In some places the surface layer is limy and contains hard concretions of lime.

Dimmick series

The Dimmick series consists of poorly drained Humic Gley soils that formed in recent alluvium on bottom lands. These fine-textured soils occur mainly in slight depressions and on wet, flat areas along the Big Sioux River and along other streams, where there is frequent flooding and a high water table.

The Dimmick soils are more mottled than the Luton soils, which are somewhat poorly drained. Unlike the very poorly drained Rauville soils, Dimmick soils do not occur in oxbows.

Profile of Dimmick clay under marsh vegetation 0.34 mile north and 200 feet west of the southeast corner of sec. 8, T. 103 N., R. 49 W.

A1A0—0 to 5 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; abundant roots and partly decomposed organic material; noncalcareous; abrupt, smooth boundary.

A11—5 to 30 inches, black (N 2/0) clay, black (N 2/0) when moist; weak, coarse and fine, subangular blocky structure; hard when dry, firm when moist; noncalcareous; gradual, smooth boundary.

Cgca—30 to 55 inches, dark-gray (10YR 4/1) clay, black (N 2/0) when moist; few, faint to prominent, olive-brown (2.5Y 4/4) mottles; weak, medium and fine, subangular blocky structure; hard when dry, firm when moist; calcareous; few, soft lime segregations; gradual, smooth boundary.

Cg—55 to 62 inches, dark-gray (5Y 4/1) clay, dark gray (N 4/0) when moist; common, faint to prominent, olive-brown (2.5Y 4/4) mottles; common black minerals; massive (structureless); very hard when dry, very firm when moist; calcareous; few, hard and soft concretions and segregations of lime.

The surface layer ranges from silty clay to clay. These fine-textured materials extend to a depth of more than 4 feet in some places. The underlying materials are stratified silt, sand, and gravel, which are limy in most places. In some places lighter colored silty alluvium has been recently deposited on the surface in a layer that is 1 to 3 inches thick.

Egeland series

The Egeland series consists of well-drained, medium-textured Chernozems that formed in eolian material of sandy loam texture, underlain by sand or glacial till. These soils occur on nearly level to sloping uplands and terraces along the eastern side of the Big Sioux River and of Skunk Creek.

The Egeland soils have a coarser textured subsoil than the Fordville and Flandreau soils and a finer textured subsoil than the excessively drained Maddock soils.

Profile of Egeland loam in an alfalfa field 510 feet west and 30 feet south of the northeast corner of sec. 16, T. 102 N., R. 49 W. (Laboratory No. 6165–6173).

A11p—0 to 4 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A12p—4 to 9½ inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; weak, very coarse, prismatic structure that breaks to weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B1—9½ to 15 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) when moist; weak, coarse, prismatic structure that breaks to weak, fine, granular structure; slightly hard when dry, friable when moist; thin, very patchy clay films on prism faces; noncalcareous; gradual, smooth boundary.

B21—15 to 19 inches, dark grayish-brown (10YR 4/2) sandy loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure that breaks to weak, fine, granular structure; soft to slightly hard when dry, friable when moist; thin, patchy clay film on prism faces; noncalcareous; gradual, smooth boundary.

B22—19 to 26 inches, dark-brown (10YR 4/3) coarse sandy loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure that breaks to weak, coarse, angular blocky structure; slightly hard when dry, very friable when moist; thin, patchy clay films on prism faces; noncalcareous; gradual, smooth boundary.

B31—26 to 33 inches, brown (10YR 4/3) loamy coarse sand, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; thin, very patchy clay films on prism faces; noncalcareous; gradual, smooth boundary.

B32—33 to 38 inches, light olive-brown (2.5Y 5/4) loamy coarse sand, dark brown (10YR 4/3) when moist; weak, coarse and very coarse, prismatic structure; soft when dry, very friable when moist; thin, very patchy clay films on prism faces; noncalcareous; clear, smooth boundary.

C1ca—38 to 52 inches, light olive-gray (5Y 6/2) coarse sand, dark grayish brown (2.5Y 4/2) when moist; massive to single grain (structureless); soft when dry, friable when moist; strongly calcareous; clear, smooth boundary.

C2ca—52 to 67 inches, light olive-gray (5Y 6/2) coarse sand, dark grayish brown (2.5Y 4/2) when moist; single grain (structureless); loose when dry or moist; strongly calcareous; clear, smooth boundary.

Ccs—67 to 108 inches, light olive-gray (5Y 6/2) stratified sand and loam, olive gray (5Y 5/2) when moist; few, faint, dark yellowish-brown (10YR 4/4) iron stains; calcareous; few, small and medium, hard concretions of lime; few nests of salt; clear, smooth boundary.

D—108 to 114 inches, multicolored sand and gravel; single grain (structureless); calcareous.

The A horizon ranges from loam to fine sandy loam. Stratified sand and silt may occur within the solum. In most places the underlying material is fine sand, but a stratum of coarse sand or gravel may occur below a depth of 3 feet.

Estelline series

The Estelline series consists of well-drained Chernozems that formed in loess or alluvial silts over gravel and sand. These soils occur on level and gently sloping terraces or in areas of glacial outwash on uplands. The main areas are on terraces along the Big Sioux River and along Split Rock, Beaver, and Skunk Creeks.

Estelline soils occur with the Fordville soils but have a smaller total acreage in this county. They are deeper to sand and gravel. This underlying material differs from the underlying glacial till of the Kranzburg soils and the underlying sand of the Flandreau soils.

Profile of Estelline silt loam in a cultivated field 240 feet north and 78 feet east of the southwest corner of sec. 11, T. 101 N., R. 48 W

A1p—0 to 7 inches, very dark brown (10YR 2/2) silt loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B1—7 to 15 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; thick, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

B21—15 to 22 inches, brown (10YR 5/3) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, coarse and medium prisms that break to moderate, medium, subangular blocks; slightly hard when dry, friable when moist; thick, continuous clay skins on prism faces; noncalcareous; gradual, smooth boundary.

B22—22 to 46 inches, light yellowish-brown (10YR 6/4) silty clay loam, brown (10YR 4/3) when moist; few, fine, yellowish-brown (10YR 5/6) mottles; moderate, medium prisms that break to moderate, medium and fine, subangular blocks; slightly hard when dry, friable when moist; thick, continuous clay films on the ped faces; noncalcareous; abrupt, smooth boundary.

D—46 to 52 inches, light yellowish-brown (10YR 6/4) fine sand, dark yellowish brown (10YR 4/4) when moist; single grain (structureless); loose when dry or moist; noncalcareous; abrupt, smooth boundary.

Dca—52 to 60 inches, very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) when moist; single grain (structureless); loose when dry or moist; strongly calcareous. (Gravel strata occur below 64 inches.)

The A horizon ranges from 5 to 8 inches in thickness, from grayish brown to very dark brown in color, and from loam to silt loam in texture. The sand or gravel is stratified in some places and is at a depth of 36 to 50 inches. In some areas the lime zone occurs in the lower part of the B horizon or in the D horizon.

Flandreau series

In the Flandreau series are medium-textured, well-drained Chernozems that developed in loess underlain by sand. These soils occur on nearly level to moderately sloping uplands in the eastern two-thirds of the county.

Flandreau soils are underlain by sand, whereas the Moody soils are underlain by loess and the Kranzburg soils by glacial till. The Flandreau soils are finer textured than Egeland soils and have a better developed subsoil.

Profile of Flandreau loam 90 feet east and 0.55 mile north of the north-south road, one quarter of a mile west of the southeast corner of sec. 5, T. 103 N., R. 49 W. (Laboratory No. 4625–4633).

A1p—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B1—7 to 13 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and medium prisms that break to weak, fine, subangular blocks; soft when dry, friable when moist; thin, patchy clay films on the vertical faces of the prisms; noncalcareous; gradual, smooth boundary.

B21—13 to 19 inches, dark grayish-brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse and medium, prismatic structure that breaks to weak, fine, subangular blocky structure; slightly hard when dry, friable when moist; thin, patchy clay films on prism faces; noncalcareous; clear, smooth boundary.

B22—19 to 25 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and medium prisms that break to weak, fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on the ped faces; noncalcareous; gradual, smooth boundary.

B23—25 to 32 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse prisms that break to weak, fine, subangular blocks; slightly hard when dry, friable when moist; thick, patchy clay films on the ped faces; dark minerals; noncalcareous; gradual, smooth boundary.

B3—32 to 36 inches, light olive-brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) when moist; weak, coarse prisms that break to weak, fine, subangular blocks; hard when dry, friable when moist; thin,

patchy clay films on ped faces; dark minerals; noncalcareous; clear, smooth boundary.

D-B3—36 to 40 inches, light olive-brown (2.5Y 5/3) coarse sandy loam, olive brown (2.5Y 4/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; thin, patchy clay films on ped faces; common dark minerals; noncalcareous; clear, smooth boundary.

D1ca—40 to 52 inches, multicolored loamy coarse sand with a basic color of grayish brown (2.5Y 5/2) when dry and dark grayish brown (2.5Y 4/3) when moist; single grain (structureless); loose when dry or moist; many dark minerals; strongly calcareous; common, small, hard concretions of lime; clear, smooth boundary.

D2ca—52 to 60 inches, multicolored loamy sand with basic color of light yellowish brown (2.5Y 6/3) when dry and olive brown (2.5Y 4/3) when moist; single grain (structureless); loose when dry or moist; many dark minerals; strongly calcareous.

The A horizon ranges from loam to silt loam in texture and from 5 to 9 inches in thickness. The B horizon is weakly to moderately well developed. It ranges from loam to silty clay loam in texture and from 33 to 50 inches in depth to sand. In some places lime occurs in the lower part of the subsoil or in the underlying sand.

Fordville series

In the Fordville series are somewhat excessively drained to well-drained soils in the Chernozem group. These soils developed in moderately shallow, medium-textured materials over strata of mixed sand and gravel. They occur on nearly level and gently sloping stream terraces and outwash plains.

The Fordville soils differ from the Estelline and Sioux soils in depth to gravel. Fordville soils are 10 to 36 inches deep to gravel; Estelline soils are more than 36 inches deep to gravel; and Sioux soils are less than 10 inches deep to gravel. The Fordville soils are finer textured than the sandy Hecla soils.

Profile of Fordville loam in cultivated field 135 feet east and 0.65 mile south of the northwest corner of sec. 5, T. 103 N., R. 50 W. (Laboratory No. 4601–4607).

A1p—0 to 8 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) when moist; black (10YR 2/1) ped coatings; weak, coarse, prismatic structure that breaks to weak, fine, granular structure; hard when dry, friable when moist; thin, continuous clay films on ped faces; noncalcareous; abrupt, smooth boundary.

B1—8 to 18 inches, very dark gray (10YR 3/1) clay loam, black (10YR 2/1) when moist; weak, coarse, prismatic structure that breaks to weak, fine, granular structure; soft when dry, friable when moist; thin, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

B21—18 to 23 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; black (10YR 2/1) ped coatings; weak, coarse, prismatic structure that breaks to moderate, fine, granular structure; soft when dry, friable when moist; thin, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

B22—23 to 29 inches, olive-brown (2.5Y 4/3, dry or moist) loam; weak, coarse, prismatic structure that breaks to weak, fine, granular structure; slightly hard when dry, friable when moist; thin, continuous clay films on ped faces; noncalcareous; clear, smooth boundary.

B3ca—29 to 33 inches, olive-brown (2.5Y 4/3, dry or moist) coarse sandy loam; weak, coarse, prismatic structure that breaks to weak, fine, granular structure or single grain (structureless); soft when dry, friable when moist; thin, patchy clay films on ped faces; strongly calcareous; gradual, smooth boundary.

D1ca—33 to 50 inches, brown (10YR 4/3), stratified mixed gravel and coarse sand, dark brown (10YR 3/3) when moist; bands of iron-stained materials; single grain (structureless); loose when dry or moist; strongly calcareous; clear, smooth boundary.

D2ca—50 to 60 inches, grayish-brown (10YR 5/2), stratified mixed coarse sand and gravel, very dark grayish brown (2.5Y 3/2) when moist; single grain (structureless); loose when dry or moist; strongly calcareous.

The A horizon is loam or silt loam in most places, but in a few places it is sandy loam. The structure of the B horizon is weak or moderate. Lime accumulates in the lower part of the B horizon if the depth to gravel is greater than 30 inches. If the depth is less than 30 inches, lime may occur in the underlying gravel and sand.

Hamar series

The Hamar series consists of sandy, somewhat poorly drained Humic Gley soils on flats, in swales and depressions, and on high bottoms or low terraces.

These soils occur with Hecla soils and are not extensive in the county. They are more poorly drained than the Hecla or the Athelwold soils. Hamar soils are coarser textured and better drained than the Dimmick soils.

Profile of Hamar loam 0.45 mile west and 75 feet north of the southeast corner of sec. 28, T. 102 N., R. 49 W.

A1p—0 to 5 inches, dark-gray (N 4/0) loam, black (N 1/0) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A1—5 to 12 inches, dark-gray (N 4/0) sandy loam, black (N 1/0) when moist; weak, coarse and medium, blocky structure that breaks to weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, wavy boundary.

B1g—12 to 21 inches, dark grayish-brown (2.5Y 4/2) sandy loam, very dark grayish brown (2.5Y 3/1) when moist; weak, medium, subangular blocky structure that breaks to weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, wavy boundary.

B21g—21 to 28 inches, grayish-brown (2.5Y 5/2) sandy loam, very dark grayish brown (2.5Y 3/2) when moist; few, fine, faint, reddish-yellow (7.5YR 6/6) and strong-brown (7.5YR 5/6) mottles; weak, coarse and medium, prismatic structure; soft when dry, very friable when moist; noncalcareous; clear, wavy boundary.

B22—28 to 34 inches, light brownish-gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) when moist; fine, distinct, reddish-brown (5YR 5/4) and strong-brown (7.5YR 5/6) mottles; weak, coarse, medium, and fine, prismatic structure; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C—34 to 39 inches, light olive-brown (2.5Y 5/6) sandy loam, light olive brown (2.5Y 5/4) when moist; many, fine, prominent mottles; massive (structureless); slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

Dg—39 to 52 inches, light olive-gray (5Y 6/2) clay loam, olive gray (5Y 5/2) when moist; many, prominent mottles of dark reddish brown (5YR 3/3), gray, and yellow; massive (structureless); slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

D—52 to 60 inches, multicolored fine gravel that shows grays, browns, and dark reddish browns; loose when dry or moist; noncalcareous.

The A horizon ranges from loam to sandy loam. The B horizon is grayish brown to brownish gray with faint and prominent, gray, yellow, and brown mottles. The underlying material generally is stratified clay, sand, and gravel, but the clay layer is absent in places. Lime is in the lower part of the B horizon in some areas.

Hecla series

In the Hecla series are moderately well drained, sandy Regosols. These soils developed in water-laid sediments that have been reworked by wind. They are not extensive and occur on nearly level to gently sloping, somewhat hummocky high bottoms or stream terraces.

Hecla soils are not so well drained as the excessively drained Maddock soils and well-drained Egeland soils. They are better drained than the associated Hamar soils. The Hecla soils are coarser textured than the Egeland soils.

Profile of Hecla fine sandy loam in a cultivated field 150 feet south and 150 feet east of north quarter corner of sec. 33, T. 102 N., R. 49 W.

A1p—0 to 9 inches, grayish-brown (2.5Y 5/2) fine sandy loam, black (N 2/0) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A1—9 to 16 inches, very dark grayish-brown (2.5Y 3/2) sandy loam, very dark gray (N 3/0) when moist; weak, coarse, prismatic structure that breaks to weak, fine, granular structure; soft when dry, very friable when moist; thin, patchy clay films on prism faces; noncalcareous; clear, smooth boundary.

C1—16 to 26 inches, light brownish-gray (2.5Y 6/2) loamy sand, dark grayish brown (2.5Y 4/2) when moist; weak, fine and medium, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C2—26 to 32 inches, very pale brown (10YR 7/3) loamy sand, yellowish brown (10YR 5/4) when moist; many, fine, faint and prominent mottles of gray, yellow, and brown; weak, fine and medium, subangular blocky structure; loose when dry or moist; noncalcareous; abrupt, smooth boundary.

Cca—32 to 60 inches, very pale brown (10YR 7/3) fine sandy loam, dark yellowish brown (10YR 4/4) when moist; many, prominent mottles of gray, yellow, and brown; single grain (structureless); loose when dry or moist; calcareous.

The A horizon ranges from black to grayish brown in color and from 6 to 10 inches in thickness. In some places the lime zone occurs in the lower part of the subsoil, but in most places it is below a depth of 24 inches. The underlying material contains fine and coarse sand and fine gravel.

Hidewood series

In the Hidewood series are somewhat poorly drained Humic Gley soils that formed in moderately fine textured local alluvium. These soils are in nearly level areas in swales, depressions, and at heads of drainageways.

The Hidewood soils are better drained than the Parnell soils but are not so well drained as the Trent or Brookings soils.

Profile of Hidewood silty clay loam in a cultivated field 0.1 mile south and 100 feet east of northwest corner of sec. 29, T. 104 N., R. 48 W.

A1p—0 to 7 inches, very dark gray (N 3/0) silty clay loam, black (N 2/0) when moist; strong, coarse, subangular blocky structure that breaks to moderate, medium and fine, granular structure; hard when dry, firm when moist; noncalcareous; abrupt, smooth boundary.

A1—7 to 15 inches, very dark gray (N 3/0) silty clay loam, black (N 2/0) when moist; few, fine, dark-brown mottles; strong, coarse, subangular blocky structure that breaks to moderate, medium and fine, subangular blocky and granular structure; hard when dry, firm when moist; noncalcareous; gradual, smooth boundary.

Cg—15 to 20 inches, very dark grayish-brown (2.5Y 3/2) silty clay loam, black (N 2/0) when moist; few, fine, dark-brown mottles; weak, fine and medium, prismatic structure; hard when dry, firm when moist; thick, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

C2—20 to 28 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, olive brown (2.5Y 4/4) when moist; few, fine, dark-brown mottles; weak, medium and fine, prismatic structure; hard when dry, firm when moist; thick, continuous clay films on ped faces; noncalcareous; clear, smooth boundary.

C3ca—28 to 42 inches, pale-yellow (2.5Y 7/4) silty clay loam, light olive brown (2.5Y 5/4) when moist; few, fine, yellow and dark-brown mottles; weak, medium and fine, prismatic structure; hard when dry, firm when moist; calcareous; gradual, smooth boundary.

D1—42 to 49 inches, yellow (2.5Y 7/6) sandy loam, olive yellow (2.5Y 6/6) when moist; many, distinct, dark-brown mottles; massive (structureless); slightly hard when dry, friable when moist; calcareous; abrupt, smooth boundary.

D2—49 to 60 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) when moist; many, fine, distinct, gray and brown mottles; massive (structureless); hard when dry, very firm when moist; calcareous.

The A horizon ranges from 10 to 18 inches in thickness and from moderate to strong, subangular blocky in structure. Generally the texture is silty clay loam, but in some places it is silty clay. The C horizon ranges from black in the upper part to light olive brown in the lower part. The mottles are grays, yellows, and browns, and they vary in abundance and in prominence. The underlying material is loess or glacial till. The layer of sand or gravel above the glacial till may be absent. Within a short distance, the depth to lime varies. Lime is at the surface in some areas. If these limy areas are large enough, they are mapped as a calcareous phase of Hidewood soils.

Kranzburg series

In the Kranzburg series are well-drained, medium-textured and moderately fine textured Chernozems that developed in a mantle of loess or loesslike material over glacial till. The slopes range from 1 to 9 percent. These soils are extensive in the western third of the county and are scattered in the rest of the county.

In the Kranzburg soils the lower part of the solum developed in glacial till, but in the Moody soils the solum developed in loess. The Kranzburg soils are not so fine textured as the Sinai soils. They are better drained than the Hidewood and Parnell soils.

Profile of Kranzburg silty clay loam in a cultivated field 0.45 mile north and 150 feet west of the south quarter corner of sec. 10, T. 102 N., R. 51 W. (Laboratory No. 4583–4591).

A1p—0 to 5 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B21—5 to 10 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that breaks to weak, fine, granular and subangular blocky structure; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; clear, wavy boundary.

B22—10 to 17 inches, light olive-brown (2.5Y 5/4) silty clay loam, dark brown (10YR 4/3) when moist; weak, medium prisms that break to weak, medium and fine, subangular blocks; hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B23—17 to 24 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; moderate, coarse prisms that break to weak, medium and fine, subangular blocks; hard when dry, friable when moist; thin, continuous clay films on ped faces; noncalcareous; clear, smooth boundary.

B24—24 to 27 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; moderate, coarse prisms that break to weak, medium and fine, subangular blocks; slightly hard when dry, friable when moist; thin, continuous clay films on the ped faces; noncalcareous; clear, smooth boundary.

B3ca—27 to 35 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, faint, yellowish-brown (10YR 5/8) stains; weak, coarse prisms that break to weak, medium, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; few to common, small, soft and hard concretions of lime; moderately calcareous; gradual, wavy boundary.

B–Dca—35 to 41 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; few, fine, distinct, yellowish-brown (10YR 5/8) stains; weak, coarse prisms that break to weak, medium, subangular blocks; hard when dry, friable when moist; thin, patchy clay films on ped faces; strongly calcareous; few to common, soft and hard concretions of lime; clear, smooth boundary.

D1ca—41 to 50 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) when moist; few, fine, distinct, yellowish-brown (10YR 5/8) stains; weak and moderate, coarse prisms that break to weak, medium, subangular blocks; hard when dry, firm when moist; thin, continuous clay films on ped faces; strongly calcareous; few, medium, soft and hard concretions of lime; gradual, wavy boundary.

D2ca—50 to 60 inches, light olive-brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/4) when moist; few, fine, prominent, yellowish-brown (10YR 5/8) stains; weak, coarse, prismatic structure that breaks to moderate, medium, prismatic structure; hard when dry, firm when moist; thin, continuous clay films on ped faces; calcareous; few, small, soft segregations of lime.

The A horizon ranges from 4 to 8 inches in thickness. The solum is 18 to 40 inches thick over glacial till or stratified materials. Depth to lime ranges from 18 to 27 inches.

Lamoure series

In the Lamoure series are calcareous, moderately fine textured, somewhat poorly drained Humic Gley soils that formed in recent alluvium on level flood plains of rivers and streams. These soils are in long, narrow strips in most places and make up a large total acreage.

The Lamoure soils developed in coarser textured alluvium than Luton soils and are calcareous nearer the surface. They are better drained than the fine-textured Dimmick soils.

Profile of Lamoure silty clay loam in a pasture 160 feet north and 80 feet east of the southwest corner of sec. 11, T. 104 N., R. 49 W.

A1—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, subangular blocky structure that breaks to weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; gradual, smooth boundary.

AC—7 to 15 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure, or to weak, fine, granular structure; slightly hard when dry, friable when moist; thick, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

C1gca—15 to 29 inches, gray (10YR 6/1) silty clay loam, black (10YR 2/1) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, blocky structure, or to weak, fine, granular structure; slightly hard when dry, firm when moist; thick, continuous clay films on ped faces; strongly calcareous; few, fine, lime concretions and large white eyes or lime segregations; abrupt, wavy boundary.

C2gca—29 to 40 inches, white (10YR 8/1) silt loam, light gray (10YR 7/1) when moist; weak, medium, prismatic structure; soft when dry, friable when moist; extremely calcareous; abrupt, smooth boundary.

Dca—40 to 60 inches, very pale brown (10YR 7/4) sand and gravel, light yellowish brown (10YR 6/4) when moist; single grain (structureless); loose when dry or moist; slightly calcareous.

The Lamoure soils are generally calcareous at the surface. The surface layer ranges from silt loam to silty clay loam. In places the depth to sand and gravel is more than 40 inches.

La Prairie series

In La Prairie soils are moderately well drained Alluvial soils that developed in silty alluvium in swales and in drainageways. These soils occur in all parts of the county, generally in small areas, but the total acreage is fairly large.

In swales in the western part of the county, La Prairie soils are intermingled with Brookings and Parnell soils. They are coarser textured than the Lamoure and Luton soils and are better drained, and leached to a greater depth.

Profile of La Prairie silt loam in cultivated field 0.25 mile south and 0.5 mile west of the northeast corner of sec. 10, T. 102 N., R. 48 W. (Laboratory No. 6229–6237).

A1p—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B1—7 to 12 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) when moist; weak, coarse prisms that break to weak, fine granules; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B21—12 to 22 inches, very dark gray (2.5Y 3/1) loam, black (2.5Y 2/1) when moist; weak, coarse prisms that break to weak, fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on the ped faces; noncalcareous; gradual, smooth boundary.

B22—22 to 29 inches, dark grayish-brown (2.5Y 4/2) loam, black (2.5Y 2/2) when moist; weak, coarse prisms that break to weak, fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B23—29 to 35 inches, dark grayish-brown (2.5Y 4/2) loam, black (2.5Y 2/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B31—35 to 40 inches, dark grayish-brown (2.5Y 4/2) loam, black (2.5Y 2/2) when moist; weak, very coarse, prismatic structure; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; clear, smooth boundary.

B32ca—40 to 45 inches, dark grayish-brown (2.5Y 4/2) loam, black (2.5Y 2/2) when moist; weak, very coarse, prismatic structure; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; strongly calcareous; few, small, soft lime segregations; clear, smooth boundary.

B33ca—45 to 57 inches, gray (2.5Y 5/1) loam, very dark grayish brown (2.5Y 3/2) when moist; few, fine, faint iron stains; weak, very coarse, prismatic structure; hard when dry, friable when moist; thin, patchy clay films on ped faces; strongly calcareous; few, small, soft lime segregations; clear, smooth boundary.

Cca—57 to 62 inches +, gray (2.5Y 5/1) sandy loam, olive brown (2.5Y 3/3) when moist; few, fine, faint iron stains; single grain (structureless); loose when dry or moist; strongly calcareous.

The dark color of the A and B horizons extends to a depth of 2 to 4 feet. The depth to lime in most places is 40 inches, but the range is from 30 to 56 inches. Buried soil profiles are common.

Luton series

In the Luton series are fine textured, somewhat poorly drained Humic Gley soils that formed in recent alluvium on level flood plains of rivers and streams. They are generally slightly acid but are alkaline in small areas. Lime has accumulated in the lower part of the subsoil in most places. These soils are extensive in the bottom lands of the Big Sioux River.

The Luton soils are not so well drained as the coarser textured La Prairie soils. The Luton soils developed in finer textured alluvium than the Lamoure soils and are noncalcareous to a greater depth.

Profile of Luton silty clay in cultivated field 230 feet south and 230 feet west of the east quarter corner of sec. 20, T. 103 N., R. 49 W. (Laboratory No. 4617–4624).

A1p—0 to 7 inches, very dark gray (10YR 3/1) silty clay, black (2.5Y 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A1—7 to 17 inches, very dark gray (2.5Y 3/1) silty clay, black (2.5Y 2/1) when moist; weak, coarse prisms that break to moderate, fine and very fine, subangular blocks; slightly hard when dry, firm when moist; thin, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

C1—17 to 26 inches, very dark gray (2.5Y 3/1) silty clay, black (2.5Y 2/1) when moist; moderate, fine and very fine, subangular blocky structure; hard when dry, firm when moist; moderately thick, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

C1g—26 to 33 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) when moist; moderate, coarse prisms that break to moderate, fine and very fine, subangular blocks; very hard when dry, firm when moist; moderately thick, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

C2—33 to 44 inches, dark-gray (2.5Y 4/1) silty clay loam, very dark gray (2.5Y 3/1) when moist; moderate, coarse prisms that break to strong, fine and very fine, subangular blocks; very hard when dry, very firm when moist; thick, continuous clay films on ped faces; noncalcareous; clear, wavy boundary.

C2ca—44 to 49 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) when moist; few, fine, faint, yellowish-brown (10YR 5/4) iron stains; weak, coarse prisms that break to weak, fine, subangular blocks; thin, continuous clay films on ped faces; strongly calcareous; common, small and medium, hard concretions of lime; gradual, wavy boundary.

C3ca—49 to 54 inches, grayish-brown (2.5Y 5/2) silt loam, olive brown (2.5Y 3/3) when moist; weak, coarse prisms that break to moderate, fine and very fine, subangular blocks; hard when dry, friable when moist; thin, continuous clay films on ped faces; strongly calcareous; few, small, soft and hard concretions of lime; clear, smooth boundary.

C4ca—54 to 60 inches, gray (2.5Y 5/1) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse prisms that break to moderate, fine and very fine, subangular blocks; hard when dry, friable when moist; thin, continuous clay films on ped faces, weakly calcareous; few, small, hard concretions of lime.

The texture of the A and B horizons ranges from silty clay loam to clay. The depth to lime ranges from 20 to 50 inches. The underlying material may be a buried soil or stratified sand, silt, and gravel.

Maddock series

In the Maddock series are somewhat excessively drained Regosols that developed in moderately coarse textured and coarse textured material deposited and reworked by wind. These soils are on uplands and on outwash that extends from eskers and kames. They also occur on the top of knolls that extend in a northwest-southeast direction and on the east side of the breaks along the Big Sioux River and Skunk Creek. The slopes range from 3 to 17 percent.

Maddock soils occur with the Egeland and Flandreau soils but have coarser texture and less development in the subsoil than those soils.

Profile of Maddock loamy fine sand in cultivated field 0.32 mile south and 85 feet east of the northwest corner of sec. 6, T. 104 N., R. 47 W.

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, loose when moist; noncalcareous; abrupt, smooth boundary.

AC—6 to 10 inches, very dark grayish-brown (10YR 3/2) and yellowish-brown (10YR 5/4) loamy sand, very dark brown (10YR 2/2) and dark brown (10YR 4/3) when moist; weak, medium, prismatic structure; soft when dry, loose when moist; noncalcareous; gradual, smooth boundary.

C1—10 to 15 inches, yellowish-brown (10YR 5/6) loamy sand, dark yellowish brown (10YR 4/4) when moist; weak, fine, subangular blocky structure; soft when dry, loose when moist; noncalcareous; clear, smooth boundary.

C2—15 to 20 inches, yellowish-brown (10YR 5/6) loamy sand, dark yellowish brown (10YR 4/4) when moist; weak, medium and fine, subangular blocky structure; soft when dry, loose when moist; noncalcareous; gradual, smooth boundary.

C3—20 to 28 inches, yellowish-brown (10YR 5/4) fine sand, dark yellowish brown (10YR 4/4) when moist; single grain (structureless); loose when dry or moist; noncalcareous; clear, wavy boundary.

C4—28 to 40 inches, yellow (10YR 7/6) fine sand, yellowish brown (10YR 5/6) when moist; single grain (structureless); loose when dry or moist; noncalcareous; gradual, smooth boundary.

Cca—40 to 65 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) when moist; single grain (structureless); loose when dry or moist; calcareous.

The A horizon ranges from 4 to 8 inches in thickness. Where it is thin, the A horizon is generally yellowish brown and is coarser textured than a thick A horizon. Gravel may occur in some places.

Moody series

In the Moody series are deep, well-drained, moderately fine textured Chernozems. These soils developed in calcareous loess on slopes of 1 to 9 percent. They are extensive on the uplands in the eastern two-thirds of the county. Most areas are cultivated.

Moody soils differ from the Nora and Crofton soils in having thicker A and B horizons, darker colors, finer texture, and a greater depth to lime. They are similar to Kranzburg soils, but their entire profile has developed in loess, whereas the Kranzburg soils developed in loess or loesslike material over glacial till.

Profile of Moody silty clay loam in cultivated field 400 feet north and 245 feet east of the southwest corner of sec. 5, T. 101 N., R. 48 W. (Laboratory No. 4678–4685).

ABp—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; very dark gray worm casts; thin, patchy clay films on ped faces in the lower part; noncalcareous; abrupt, smooth boundary.

B21—7 to 11 inches, brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that breaks to weak, fine, granular and subangular blocky structure; slightly hard when dry, friable when moist; very dark gray worm casts; thin, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

B22—11 to 17 inches, brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium prisms that break to moderate, fine, subangular blocks; slightly hard when dry, friable when moist; dark-brown worm casts; thin, continuous clay films on ped faces; noncalcareous; gradual, smooth boundary.

B23—17 to 22 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; weak, medium and fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B24—22 to 30 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; weak, medium and coarse prisms that break to weak, medium, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; clear, wavy boundary.

B3ca—30 to 42 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, distinct, light-gray (2.5Y 7/2) mottles; weak, coarse and medium, prismatic structure; soft when dry, friable when moist; thin, patchy clay films on vertical faces of peds; strongly calcareous; few, small, soft segregations and hard concretions of lime; gradual, smooth boundary.

C1ca—42 to 56 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; few, fine, distinct, light-gray (2.5Y 7/2) mottles; yellowish-brown (10YR 5/6) iron stains; massive (structureless); soft when dry, very friable when moist; strongly calcareous; few, small, soft segregations and hard concretions of lime; gradual, smooth boundary.

C2ca—56 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; common, medium, distinct, light-gray (2.5Y 7/2) mottles; yellowish-brown (10YR 5/6) iron stains; massive (structureless); soft when dry, very friable when moist; small, pipestem concretions of iron and manganese; strongly calcareous; few, small, soft segregations and hard concretions of lime.

The A horizon ranges from 5 to 8 inches in thickness. The B horizon extends to a depth of 30 or 40 inches. The texture of the B horizon is silty clay loam, but in places the upper part is silty clay loam and the lower part is silt loam. One inextensive mapping unit is moderately shallow, about 46 inches to rock. Lime accumulations may occur in the lower part of the B horizon or in the C horizon.

Nora series

In the Nora series are deep, well-drained, medium-textured Chernozems that developed in calcareous loess. These soils occur on slopes of 3 to 9 percent. They are extensive on uplands in the eastern two-thirds of the county. Almost all areas are cultivated.

Nora soils have thinner A and B horizons than Moody soils and are slightly coarser textured. Depth to lime ranges from 10 to 30 inches in the Nora soils, but is below 30 inches in the Moody soils. Nora soils have a better developed subsoil and are leached deeper than the Crofton soils.

Profile of Nora silt loam in cultivated field 400 feet north and 85 feet east of the southwest corner of sec. 5, T. 102 N., R. 48 W. (Laboratory No. 6192–6200).

ABp—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B21—5 to 12 inches, olive-brown (2.5Y 4/4) silt loam, very dark grayish brown (2.5Y 3/2) when moist; weak, medium and coarse prisms that break to weak, medium and fine, subangular blocks; soft when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B22—12 to 18 inches, olive-brown (2.5Y 4/4) silt loam, very dark grayish brown (2.5Y 3/2) when moist; weak, coarse prisms that break to weak, medium and fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on the ped faces; noncalcareous; abrupt, smooth boundary.

B23ca—18 to 24 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; weak, coarse and medium prisms that break to weak, medium and fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; strongly calcareous; few, small, soft segregations and hard concretions of lime; gradual, smooth boundary.

B24ca—24 to 31 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; weak, coarse, prismatic structure; soft when dry, friable when moist; few worm casts; thin, patchy clay films on ped faces; strongly calcareous; few, small, soft segregations and hard concretions of lime; gradual, smooth boundary.

B25ca—31 to 38 inches, light olive-brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, faint iron stains; weak, coarse, prismatic structure; soft when dry, friable when moist; few worm casts; thin, patchy clay films on ped faces; strongly calcareous; few, small, soft segregations and hard concretions of lime; gradual, smooth boundary.

B31ca—38 to 45 inches, light yellowish-brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) when moist: few, fine, faint, iron and manganese stains; weak, very coarse, prismatic structure; soft when dry, friable when moist; few worm casts; thin, patchy clay films on ped faces; strongly calcareous, few, small, soft segregations and hard concretions of lime; gradual, smooth boundary.

B32ca—45 to 55 inches, light yellowish-brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) when moist; few, fine, distinct, yellowish-brown (10YR 5/8) iron stains and black (10YR 2/1) manganese stains; weak, very coarse, prismatic structure; soft when dry, friable when moist; few worm casts; thin, patchy clay films on ped faces; strongly calcareous; few, small segregations and hard concretions of lime; clear, smooth boundary.

Cca—55 to 67 inches +, light yellowish-brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) when moist; common, medium, distinct, yellowish-brown (10YR 5/8) iron stains and few, fine, distinct, black (10YR 2/1) manganese stains; massive (structureless); soft when dry, friable when moist; calcareous; few, small lime segregations.

The A horizon ranges from 3 to 6 inches in thickness. Where the A horizon is thin, it is lighter colored than it is where it is thick because the upper part of the B horizon has been mixed into the plowed layer. The differences in thickness of A and B horizons and in the depth to lime generally are caused by erosion and the position of the soil on the slope. Soils that have thicker A and B horizons and are deeper to lime occur on smoother slopes. Those that have thinner horizons and are shallower to lime occur on knolls and the more convex slopes.

Parnell series

In the Parnell series are poorly drained, moderately fine textured and fine textured Humic Gley soils that formed in local colluvium and alluvium and in glacial alluvium. These soils are in flat depressions and potholes in the western and southeastern parts of the county.

Parnell soils are more poorly drained than the Hidewood and the Luton soils. They are leached deeper and are not so fine textured as the Dimmick soils.

Profile of Parnell silty clay loam 1,720 feet north and 60 feet west of the southeast corner of sec. 15, T. 101 N., R. 51 W.

A00—4 to 3 inches, undecomposed organic matter, twigs, and leaves; noncalcareous; abrupt boundary.

A0—3 inches to 0; dark grayish-brown (10YR 4/2) undecomposed and partly decomposed organic matter, very dark brown (10YR 2/2) when moist; estimated organic matter, 60 to 70 percent; noncalcareous; clear boundary.

A11—0 to 4 inches, dark-gray (10YR 4/1) and dark grayish-brown (10YR 4/2) silty clay loam, black (10YR 2/1) when moist; common, fine, distinct, dark reddish-gray (5YR 4/2) mottles, reddish brown (5YR 4/4) when moist; moderate, fine, granular structure; friable when moist, slightly sticky and plastic when wet; estimated organic matter, 20 percent; noncalcareous; clear boundary.

A12—4 to 10 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; moderate, very fine, blocky and subangular blocky structure; firm when moist, sticky and plastic when wet; noncalcareous; clear boundary.

B21—10 to 17 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; moderate, very fine, blocky structure; firm when moist, sticky and plastic when wet; clay films on most ped faces; noncalcareous; gradual boundary.

B22—17 to 27 inches, dark-gray (5Y 4/1) silty clay, black (10YR 2/1) when moist; moderate, medium, subangular blocky structure that breaks to strong, very fine, blocky structure; firm when moist, sticky and plastic when wet; clay films on all ped faces (shiny); noncalcareous; gradual boundary.

Cg1—27 to 47 inches, dark-gray (5Y 4/1) silty clay, black (5Y 2/1) with many, coarse, faint, very dark brown (10YR 2/2) mottles when moist; firm when moist, sticky and plastic when wet; noncalcareous; gradual boundary.

Cg2—47 to 52 inches, dark-gray (5Y 4/1) silty clay, black (5Y 2/1) when moist; many, coarse, faint, very dark brown (10YR 2/2) and very dark grayish-brown (2.5Y 3/2) mottles and few, fine, prominent, black (N 2/0) mottles when moist; firm when moist, sticky and plastic when wet; noncalcareous; clear boundary.

Cg3—52 to 60 inches, dark-gray (5Y 4/1) clay, black (5Y 2/1) when moist; few pebbles; few, medium, distinct, dark-gray (N 4/0) and common, medium, distinct, dark grayish-brown (2.5Y 4/2) mottles; moist soil has few, medium, distinct, dark-gray (N 4/0) mottles, few, fine, prominent, black (N 2/0) mottles, and common, medium, distinct, very dark grayish-brown (2.5Y 3/2) and dark grayish-brown (2.5Y 4/2) mottles; firm when moist, sticky and plastic when wet; few rounded concretions of iron ⅛ to ¼ inch in diameter; noncalcareous.

The A horizon ranges from 7 to 20 inches in thickness. This thickness is determined by the amount of sediment washed from adjacent uplands into the depressions and potholes. The A12, B21, and B22 horizons are slightly darker when moist than the A11 horizon, but their color can still be identified on the 10YR color card, or chip. The B and C horizons are calcareous in some places. In some places crystals and nests of gypsum occur in the lower part of the subsoil.

Rauville series

In the Rauville series are very poorly drained, moderately fine textured and fine textured Humic Gley soils. These soils formed in recent alluvium in nearly flat, concave depressions and swales of the bottom lands along the Big Sioux River and Skunk Creek. In this county the total area of these soils is small.

The Rauville soils occur with the Lamoure, Luton, and Dimmick soils and are very poorly drained.

Profile of Rauville silty clay loam 0.35 mile north and 50 feet west of the southeast corner of sec. 8, T. 103 N., R. 49 W.

A11—0 to 4 inches, very dark gray (N 3/0) silty clay loam, black (N 2/0) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

A12—4 to 13 inches, very dark gray (N 3/0) clay, black (N 2/0) when moist; moderate, medium and very fine, subangular blocky structure; hard when dry, firm when moist; noncalcareous; diffuse, smooth boundary.

Cg1—13 to 32 inches, dark-gray (N 4/0) clay, black (N 2/0) when moist; moderate, very fine, subangular blocky structure; hard when dry, firm when moist; noncalcareous; diffuse, smooth boundary.

Cg2—32 to 60 inches, dark-gray (N 4/0) clay, black (N 2/0) when moist; massive (structureless); hard when dry, firm when moist; noncalcareous.

The A11 horizon varies in amount of undecomposed organic matter and ranges in texture from clay to silty clay loam. The profile is calcareous in some places. Visible mottles in the lower part of the A and in the C horizon vary because the mottles are generally masked by stains of organic matter. The substratum is gravel or sand in some places and is below a depth of 40 inches in most places.

Sinai series

The Sinai series consists of well-drained, moderately fine textured and fine textured soils in the Chernozem group. These soils occur on broad, rounded hilltops and are generally surrounded by a narrow band of eroded soil in silty glacial till. The soil on the slopes intergrades to Kranzburg silty clay loam. These inextensive Sinai soils are in the western one-third of the county. Slopes range from 1 to 5 percent.

The Sinai soils are slightly coarser textured than the Corson soils. They occur with the Kranzburg soils and are grayer, more clayey, and more blocky in the B horizon than those soils.

Profile of Sinai silty clay in a cultivated field 175 feet south and 370 feet west of the northeast corner of sec. 19, T. 104 N., R. 52 W. (Laboratory No. 4568–4574).

A1p—0 to 8 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B21—8 to 19 inches, grayish-brown (2.5Y 5/2) silty clay, olive brown (2.5Y 4/4) when moist; weak, medium prisms that break to moderate, fine and very fine, subangular blocks; hard when dry, firm when moist; moderately thick, continuous clay films on ped faces; noncalcareous; clear, wavy boundary.

B22ca—19 to 28 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; few, fine, distinct, strong-brown (7.5Y 5/6) iron stains; weak, medium and coarse prisms that break to moderate, medium, fine and very fine, subangular blocks; hard when dry, friable when moist; moderately thick, continuous clay films on ped faces; calcareous; common, medium and large, soft segregations and a few, small, hard concretions of lime; gradual, wavy boundary.

B23ca—28 to 36 inches, silty clay loam with no matrix color; many, medium, distinct, light olive-brown (2.5Y 5/4) and light-gray (2.5Y 7/2) mottles; grayish-brown (2.5Y 5/2) ped coatings; dark yellowish-brown (10YR 4/4) iron stains; weak, medium and coarse prisms that break to moderate, medium, fine and very fine, subangular and angular blocks; thin, continuous and thick, patchy clay films on ped faces; strongly calcareous; common, medium and large, soft segregations and few, small, hard concretions of lime; gradual, wavy boundary.

B24ca—36 to 44 inches, light brownish-gray (2.5Y 6/2) silty clay loam, gray (2.5Y 5/1) when moist; yellowish-brown (10YR 5/6) iron stains in root channels; weak, coarse and medium prisms that break to moderate, medium and fine, angular blocks; very hard when dry, very firm when moist; thin, continuous and thick, patchy clay films on ped faces; strongly calcareous; few, medium, soft segregations of lime; gradual, wavy boundary.

B31ca—44 to 50 inches; light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; common, large, distinct, light yellowish-brown (2.5Y 6/4) mottles; weak, coarse and medium prisms that break to moderate, medium and fine, angular blocks; very hard when dry, very firm when moist; thin, continuous and thick, patchy clay films on ped faces; calcareous; few, small, soft segregations of lime; gradual, wavy boundary.

B32ca—50 to 60 inches, light-gray (2.5Y 7/2) silty clay loam, gray (2.5Y 5/1) when moist; few, medium, distinct, dark grayish-brown (10YR 4/2) mottles; moderate, medium, blocky structure; very hard when dry, very firm when moist; thin, patchy clay films on ped faces; calcareous.

The A horizon ranges from 5 to 10 inches in thickness, and from silty clay to silty clay loam in texture. The B horizon is silty clay in places, and it may contain accumulated lime at a depth of 12 to 24 inches. In some areas stratified silt and sand is immediately above a firm glacial till. The depth to glacial till ranges from 26 to 60 inches or more.

Sioux series

In the Sioux series are excessively drained Regosols that developed on uplands and on stream terraces in gravelly loam over beds of gravel and sand. Slopes range from gentle to very steep. The Sioux soils are mapped in a complex with the Buse soils and are extensive, especially in an area east of Sioux Falls.

The Sioux soils are about 8 inches to gravel, whereas the Fordville soils are about 29 inches to gravel. The Sioux soils occur with the Buse soils, which developed in glacial till.

Profile of Sioux gravelly loam 0.55 of a mile west and 75 feet north of the southeast corner of sec. 13, T. 104 N., R. 49 W.

A1p—0 to 4 inches, brown (10YR 4/3) gravelly loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

A1—4 to 8 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, prismatic structure that breaks to fine, granular structure; noncalcareous; abrupt, wavy boundary.

Dca—8 to 66 inches, sand and gravel that are mainly pale brown (10YR 6/3) when dry, and brown (10YR 5/3) when moist; other colors are grays, yellows, and browns; strongly calcareous.

The surface layer ranges from gravelly loam to sandy loam in texture. Stones and boulders vary in size and numbers on the surface and in the profile. Sand and gravel are at or near the surface in some places but may be at a depth of as much as 10 inches. The Sioux soils are calcareous at the surface in some places.

Trent series

In the Trent series are moderately well drained soils of the Chernozem group that developed in loess on level uplands, mainly in the northeastern part of the county. These soils are not extensive in other parts of the county.

The Trent soils have a thicker A horizon than Moody soils and are not so well drained. In most places they are leached deeper and are drained better than the Hidewood soils.

Profile of Trent silty clay loam in a cultivated field 0.25 of a mile west of the east side of the center of sec. 7, T. 104 N., R. 48 W. (Laboratory No. 6174–6182).

A1p—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A1—8 to 14 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, coarse prisms that break to weak, medium and fine, subangular blocks; slightly hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B1—14 to 20 inches, dark grayish-brown (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; weak, coarse and medium prisms that break to weak, medium and fine, subangular blocks; hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B21—20 to 26 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, coarse and medium prisms that break to weak, medium and fine, subangular blocks; hard when dry, friable when moist; thin, continuous and moderately thick, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B22—26 to 31 inches, grayish-brown (2.5Y 5/2) silty clay loam, olive brown (2.5Y 4/3) when moist; few, very faint iron stains; moderate, coarse and medium prisms that break to weak, medium and fine, subangular blocks; hard when dry, friable when moist; thin, continuous and moderately thick, patchy clay films on ped faces; noncalcareous; gradual, smooth boundary.

B23—31 to 39 inches, light olive-brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) when moist; few, faint iron stains; moderate, coarse and medium prisms that break to weak, medium and fine, subangular blocks; hard when dry, friable when moist; thin, patchy clay films on ped faces; noncalcareous; clear, wavy boundary.

B31ca—39 to 47 inches, light yellowish-brown (2.5Y 6/3) silt loam, light olive brown (2.5Y 5/4) when moist; few, faint iron and manganese stains; weak, very coarse, prismatic structure; hard when dry, friable when moist; thin, patchy clay films on ped faces; strongly calcareous; few, small, soft segregations and common, small and medium, hard concretions of lime; gradual, smooth boundary.

B32ca—47 to 53 inches, light yellowish-brown (2.5Y 6/3) silt loam, olive brown (2.5Y 4/4) when moist; few, fine, faint, dark-brown (10YR 4/3) iron stains; few, fine, distinct, black (10YR 2/1) manganese stains; weak, very coarse, prismatic structure; hard when dry, friable when moist; thin, very patchy clay films on ped faces; strongly calcareous; few, small, soft segregations and common, medium and small, hard concretions of lime; stratified materials with gray and iron-stained bands; gradual, smooth boundary.

Cgca—53 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; common, medium, distinct, olive-yellow (2.5Y 6/8) and few, fine, distinct, black (10YR 2/1) manganese stains; massive (structureless); hard when dry, friable when moist; stratified materials with gray and iron-stained bands; strongly calcareous; few, fine, threadlike, soft segregations of lime; few, small and medium, hard concretions of lime.

The A horizon ranges from 8 to 20 inches in thickness. The B horizon has weak to moderate, coarse and medium, prismatic structure that breaks to weak to moderate, fine, subangular blocky structure. Mottles in the B horizon vary in size and contrast and generally occur below 20 inches. In the northeastern part of the county, colored, stratified material is common in the substratum, but in some areas glacial till occurs and is generally below a depth of 40 inches.

Vienna series

In the Vienna series are well-drained Chernozems that developed in exposed glacial till on uplands in the eastern two-thirds of the county. Slopes range from 1 to 9 percent.

The Vienna soils developed in glacial till. The glacial till differentiates them from the Moody soils, which developed in loess, and Kranzburg soils which developed partly in loess. The Vienna soils, like the Beadle soils, developed in glacial till. The Beadle soils, however, have stronger structure in the B horizon than the Vienna soils and larger white-eye segregations of lime.

Profile of Vienna silt loam in an alfalfa field 0.2 mile north and 150 feet west of the east quarter corner of sec. 18, T. 101 N., R. 47 W.

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) when moist; moderate, coarse, blocky structure that breaks to weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; gradual, smooth boundary.

B2—8 to 18 inches, brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium prisms that break to weak, medium, subangular blocks; slightly hard when dry, firm

when moist; thick, continuous clay films on ped faces; noncalcareous; clear, smooth boundary.

B2ca—18 to 24 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure; hard when dry, very firm when moist; thick, continuous clay films on ped faces; strongly calcareous; common, small, soft segregations of lime; gradual, smooth boundary.

B3ca—24 to 30 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure; very hard when dry, firm when moist; thick, continuous clay films on ped faces; strongly calcareous; common, medium, soft segregations and hard concretions of lime; gradual, smooth boundary.

Cca—30 to 60 inches, light yellowish-brown (10YR 6/4) clay loam, brown (10YR 5/3) when moist; yellow (10YR 7/6) of matrix increases with increasing depth; massive (structureless); very hard when dry, very firm when moist; strongly calcareous; common, medium and small, soft segregations and hard concretions of lime.

The A horizon ranges from loam to silty clay loam because the surface material has been reworked by wind. The B horizon ranges from about 16 to 30 inches in thickness. Accumulated lime occurs at a depth of 14 to 28 inches. Variations in thickness of the horizon and depth to lime are the result of the position of the soils on the slope. The A horizon is thicker on nearly level uplands than it is on steeper slopes and on eroded knolls and breaks, and the lime zone is at a greater depth. In eroded areas where the A horizon and the upper part of the B horizon have been mixed, the plow layer is lighter colored.

Mechanical and Chemical Analyses

The data obtained by mechanical and chemical analyses for some selected soils in Minnehaha County are given in table 7. Profiles of the selected soils are described in the subsection "Technical Descriptions of Soils." These profiles can be identified by the laboratory number listed in the descriptions and in table 7. The data in table 7 are useful to soil scientists in classifying soils and in developing concepts of soil genesis. They are also helpful for estimating water-holding capacity, wind erosion, fertility, tilth, and other practical aspects of soil management.

Field and laboratory methods

All samples used to obtain the data in table 7 were collected from carefully selected pits. The samples are representative of the soil material that is made up of particles less than ¾ inch in diameter. Estimates of the fraction of the sample consisting of particles larger than ¾ inch were made during the sampling. If necessary, the sample was sieved after it was dried and rock fragments larger than ¾ inch in diameter were discarded. Then the material made up of particles less than ¾ inch was rolled, crushed, and sieved by hand to remove rock fragments larger than 2 millimeters in diameter. The fraction that consists of particles between 2 millimeters and ¾ inch in diameter is recorded on the data sheets and in table 7 as the percentage greater than 2 millimeters. This value is calculated from the total weight of the particles smaller than ¾ inch in diameter.

The content given for the fractions that consist of particles larger than ¾ inch and of particles between 2 millimeters and ¾ inch is somewhat arbitrary. The accuracy of the data depends on the severity of the preparative treatment, which may vary with the objectives of the study. But it can be said that the two fractions contain relatively unaltered rock fragments that are larger than 2 millimeters in diameter and that they do not contain slakeable clods of earthy material.

Unless otherwise noted, all laboratory analyses are made on material that passes the 2 millimeter sieve and are reported on an oven-dry basis. In table 7, values for exchangeable potassium are for amounts of potassium that have been extracted by the ammonium acetate method, minus the amounts that are soluble in the saturation extract.

Standard methods of the Soil Survey Laboratory were used to obtain most of the data in table 7. Determinations of clay were made by the pipette method (*4*, *5*, *6*). Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (*7*). The calcium carbonate equivalent was determined by measuring the volume of carbon dioxide emitted from soil samples treated with concentrated hydrochloric acid. The cation-exchange capacity was determined by direct distillation of absorbed ammonia (*7*). To determine the extractable calcium and magnesium, calcium was separated as calcium oxalate and magnesium as magnesium ammonium phosphate (*7*). Extractable potassium was determined on original extracts with a flame spectrophotometer. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract (*8*). Soluble potassium was determined on the saturation extract with a flame spectrophotometer.

TABLE 7.—*Analytical data for*

[Analyses made at Soil Survey Laboratory, Soil Conservation Service,

Soil	Horizon	Depth	Particle-size distribution: Very coarse sand (2 to 1 mm.)	Coarse sand (1 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (smaller than 0.002 mm.)	Course fragments (larger than 2 mm.)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Benclare silty clay loam.	Alp	0–7	--------	0.5	0.9	1.3	2.0	57.6	37.7	--------
Location: sec. 6, T. 101 N.,	B21	7–12	--------	.4	.9	1.2	2.1	54.7	40.7	--------
R. 47 W., 0.1 mile E. of	B22	12–19	--------	.4	1.0	1.4	2.1	54.4	40.6	--------
SW. corner and 80 feet N.	B23	19–25	--------	.7	1.3	1.7	2.7	56.5	36.8	[1]
of fence.	B21ca	25–31	--------	1.0	1.4	1.5	3.2	55.1	37.4	[1]
Survey No. S57Sd–50–6–	B22ca	31–37	--------	1.0	2.7	2.5	2.2	45.1	46.2	[1]
(1–9)	D–B23ca	37–45	--------	.4	.9	1.1	1.3	35.8	60.4	--------
Laboratory No. 6211–6219	D–B24ca	45–54	--------	.2	.6	1.4	1.1	29.7	67.0	--------
	D–B25ca	54–62+	--------	--------	.1	.2	.4	28.6	70.7	--------
Benclare silty clay loam.	A1p	0–7	.3	.4	.7	1.7	3.0	58.4	35.5	--------
Location: sec. 5, T. 101 N.,	B1	7–12	.1	.4	.6	1.4	2.5	58.2	36.8	--------
R. 47 W., 0.15 mile E. of	B21	12–19	.1	.3	.4	.8	2.0	57.2	39.2	--------
SW. corner and 55 feet N.	B22	19–26	.1	.3	.2	.5	2.3	54.7	41.9	[1]
of fence.	B23	26–32	--------	--------	.2	.5	4.0	55.4	39.9	--------
Survey No. S57Sd–50–7–	B24	32–39	--------	--------	.2	1.2	7.2	53.8	37.6	--------
(1–9)	B25ca	39–45	.1	.2	.3	2.2	8.8	53.5	34.9	--------
Laboratory No. 6220–6228	B26ca	45–55	.4	.1	.2	2.3	13.4	48.8	34.8	[1]
	B3ca	55–61+	--------	.3	.4	2.3	13.6	53.7	29.7	--------
Corson silty clay.	A1p	0–5½	.4	3.3	5.2	9.7	5.1	32.4	43.9	--------
Location: sec. 2, T. 102 N., R.	B1	5½–11	.4	2.8	4.4	11.3	5.9	26.1	49.1	--------
48 W., 325 feet S. and 0.25	B21ca	11–15	.4	2.6	3.8	9.1	4.9	27.2	52.0	--------
mile E. of NW. corner.	B22ca	15–22	.2	2.1	3.4	8.1	3.8	27.8	54.6	--------
Survey No. S56SD–50–15–	B23ca	22–28	.3	1.8	3.0	8.7	3.4	29.3	53.5	--------
(1–9)	B24ca	28–36	.6	1.3	2.0	6.1	2.1	29.8	58.1	--------
Laboratory No. 4660–4668	B25ca	36–43	.1	.7	1.9	9.0	4.4	26.9	57.0	--------
	B26ca	43–52	.1	.4	1.0	6.9	6.7	28.7	56.2	--------
	B27ca	52–60	--------	.1	.4	4.3	6.5	29.3	59.4	--------
Corson silty clay.	A1p	0–5	.2	1.5	1.7	2.1	2.0	51.7	40.8	--------
Location: sec. 14, T. 102	B21	5–9	.2	.9	1.2	1.8	2.2	50.8	42.9	--------
N., R. 48 W., 0.25 mile	B22	9–14	.1	1.1	1.4	1.7	2.5	47.3	45.9	--------
S. and 310 feet E. of NW.	B23	14–19	.2	.9	1.4	2.2	1.8	42.0	51.5	--------
corner.	B24	19–24	.2	.7	1.2	1.9	1.3	39.1	55.6	--------
Survey No. S56SD–50–18–	B25ca	24–33	.1	.5	.6	1.1	1.1	40.2	56.4	--------
(1–9)	B26ca	33–41	.1	.2	.1	.4	.5	46.7	52.0	--------
Laboratory No. 4686–4694	B27ca	41–44	--------	--------	.1	.6	.5	56.3	42.5	--------
	B28ca	44–60	--------	--------	.1	.6	.6	43.6	55.1	--------
Crofton silt loam.	ACp	0–6	.4	.2	.2	.5	5.9	69.6	23.2	--------
Location: sec. 6, T. 101	C1ca	6–13	.2	.3	.2	.4	6.7	73.2	19.0	--------
N., R. 48 W., 100 feet W.	C2ca	13–20	.6	.3	.1	.8	7.4	71.6	19.2	3.0
and 145 feet N. of SE.	C3ca	20–25	.2	.5	.2	.7	7.4	71.1	19.9	3.9
corner.	C4ca	25–30	.2	.2	.1	.7	7.3	72.3	19.2	2.6
Survey No. S56SD–50–1–	C5ca	30–40	.1	.3	.1	.4	7.8	70.9	20.4	1.8
(1–8)	C6ca	40–48	.2	.2	.1	.3	6.6	71.7	20.9	1.6
Laboratory No. 4544–4551	C7ca	48–60	.2	.2	.1	.3	7.6	72.2	19.4	1.2
Crofton silt loam.	ACp	0–6½	.1	.3	.4	1.0	8.9	63.8	25.5	--------
Location: sec. 6, T. 102 N.,	CA	6½–13	.1	.1	.2	.7	10.8	63.8	24.3	--------
R. 47 W., 75 feet W. and	C1ca	13–18	.5	.3	.4	1.4	12.9	64.6	19.9	--------
0.4 mile S. of NE. corner.	C2ca	18–26	.4	.2	.4	1.1	13.9	64.5	19.5	2.9
Survey No. S56SD–50–13–	C3ca	26–31	.2	.2	.3	1.0	14.8	64.5	19.0	2.5
(1–8)	C4ca	31–36	--------	.1	.2	.7	13.6	66.0	19.4	1.9
Laboratory No. 4643–4650	C5ca	36–44	.5	.2	.1	4.9	14.6	60.4	19.3	--------
	C6ca	44–60	.2	--------	.1	.4	11.2	70.2	17.9	--------

See footnote at end of table.

selected soil profiles

Lincoln, Nebr. Dashes indicate values not determined or do not apply]

Textural class USDA	pH	Organic carbon	Calcium carbonate equivalent	Moisture held at— Tension of 1/10 atmosphere	Moisture held at— Tension of 1/3 atmosphere	Moisture held at— Tension of 15 atmospheres	Cation-exchange capacity (NH_4OAc)	Extractable cations Ca	Extractable cations Mg	Extractable cations H	Extractable cations K	Base saturation	Calcium-magnesium ratio
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Percent*	
Silty clay loam	6.3	3.04	---	43.8	32.8	16.4	33.6	22.4	6.5	8.7	0.9	89	3.4
Silty clay	6.8	2.14	---	42.2	32.4	18.0	33.4	24.2	7.2	7.8	.4	96	3.4
Silty clay	7.3	1.40	---	39.8	31.2	17.4	31.0	24.0	7.3	4.3	.4	100	3.3
Silty clay loam	8.1	.88	10	38.8	29.4	14.9	26.2	---	---	---	.4	---	---
Silty clay loam	8.2	.42	18	37.0	28.8	14.3	23.1	---	---	---	.4	---	---
Silty clay	8.2	.27	19	39.1	31.1	16.7	24.6	---	---	---	.4	---	---
Clay	8.1	.28	20	44.7	36.3	21.4	29.9	---	---	---	.6	---	---
Clay	8.1	.21	17	47.1	39.9	22.9	29.9	---	---	---	.6	---	---
Clay	8.0	.19	17	51.8	41.7	24.7	32.0	---	---	---	.7	---	---
Silty clay loam	6.2	3.83	---	50.8	35.3	16.9	33.2	22.4	5.5	9.4	1.5	88	4.1
Silty clay loam	6.3	2.81	---	38.3	28.8	16.2	31.7	22.4	5.5	8.1	.9	91	4.1
Silty clay loam	6.4	1.85	---	37.1	28.5	16.3	30.8	22.7	6.0	6.4	.7	96	3.8
Silty clay	6.7	.98	---	33.6	27.3	16.7	30.7	22.7	6.6	6.0	.7	98	3.4
Silty clay loam	6.7	.69	---	35.8	28.4	16.6	29.2	21.8	6.2	4.3	.6	98	3.5
Silty clay loam	6.8	.49	---	33.6	26.5	15.8	27.4	20.6	6.1	4.3	.5	100	3.4
Silty clay loam	7.9	.35	14	34.1	27.2	15.2	24.3	---	---	---	.4	---	---
Silty clay loam	8.1	.23	16	33.5	26.8	15.1	21.6	---	---	---	.4	---	---
Silty clay loam	8.1	.18	19	36.7	26.8	12.8	19.4	---	---	---	.4	---	---
Clay	6.7	2.01	1	35.6	28.1	17.5	33.2	26.5	6.1	3.8	.8	100	4.3
Clay	7.2	1.03	2	36.0	29.3	17.8	32.4	35.8	5.8	1.3	.6	100	6.2
Clay	7.9	.84	14	34.6	27.7	16.8	29.7	---	---	---	.4	---	---
Clay	7.9	.58	18	37.3	29.7	17.6	28.1	---	---	---	.5	---	---
Clay	7.9	.40	18	33.1	30.4	17.4	27.4	---	---	---	.5	---	---
Clay	7.9	.29	18	36.4	33.3	19.4	28.0	---	---	---	.5	---	---
Clay	7.9	.20	16	35.4	32.7	19.0	27.0	---	---	---	.5	---	---
Clay	7.9	.14	16	35.8	33.5	19.7	27.1	---	---	---	.5	---	---
Clay	7.8	.15	17	37.3	35.2	20.3	27.9	---	---	---	.5	---	---
Silty clay	6.1	3.05	---	44.1	31.7	16.6	33.0	25.8	5.6	8.5	.8	98	4.6
Silty clay	6.0	2.43	---	41.3	32.9	17.7	32.7	24.9	5.8	7.3	.6	96	4.3
Silty clay	6.3	1.77	---	39.6	32.2	18.0	33.2	24.9	6.4	6.0	.6	96	3.9
Silty clay	6.3	1.24	---	39.4	33.6	18.9	35.3	27.4	7.3	4.7	.6	100	3.8
Clay	6.9	.94	---	43.2	35.1	20.6	36.7	29.9	7.9	3.4	.6	100	3.8
Silty clay	7.8	.66	15	41.1	33.8	19.3	32.2	38.4	8.0	1.3	.5	100	4.8
Silty clay	8.0	.38	23	41.3	33.4	18.5	28.4	---	---	---	.4	---	---
Silty clay	7.9	.29	24	40.0	32.8	16.3	24.2	---	---	---	.4	---	---
Silty clay	7.8	.29	21	44.9	36.8	20.1	27.4	---	---	---	.5	---	---
Silt loam	7.9	2.02	1	42.3	25.3	11.0	21.1	29.1	3.7	.4	.4	100	7.9
Silt loam	8.1	.74	15	34.4	22.2	8.8	15.8	---	---	---	.2	---	---
Silt loam	8.1	.47	13	35.4	21.3	8.7	15.9	---	---	---	.2	---	---
Silt loam	8.2	.36	12	36.9	21.7	8.9	16.2	---	---	---	.2	---	---
Silt loam	8.2	.28	15	39.0	21.3	8.7	15.6	---	---	---	.2	---	---
Silt loam	8.2	.23	12	39.6	22.1	8.9	16.0	---	---	---	.2	---	---
Silt loam	8.2	.18	11	41.5	24.2	9.2	16.6	---	---	---	.3	---	---
Silt loam	8.3	.14	13	41.7	23.7	9.2	15.9	---	---	---	.2	---	---
Silt loam	7.7	2.15	1	40.9	25.0	12.4	24.1	25.2	4.6	2.1	.5	100	5.5
Silt loam	7.7	1.28	1	36.5	21.9	12.1	21.6	21.2	4.9	1.7	.3	100	4.3
Silt loam	7.9	.65	13	32.5	19.0	9.0	15.3	---	---	---	.2	---	---
Silt loam	8.1	.36	15	31.8	18.0	8.1	14.6	---	---	---	.2	---	---
Silt loam	8.1	.24	13	34.5	17.3	7.6	14.2	---	---	---	.3	---	---
Silt loam	8.1	.20	14	36.1	17.4	7.9	14.5	---	---	---	.3	---	---
Silt loam	8.1	.15	15	37.0	18.6	8.2	14.3	---	---	---	.3	---	---
Silt loam	8.2	12	13	36.9	17.7	7.8	13.6	---	---	---	.3	---	---

TABLE 7.—*Analytical data for*

[Analyses made at Soil Survey Laboratory, Soil Conservation Service,

Soil	Horizon	Depth	Particle-size distribution: Very coarse sand (2 to 1 mm.)	Coarse sand (1 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (smaller than 0.002 mm.)	Course fragments (larger than 2 mm.)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Egeland loam.	A11p	0–4	3.9	13.9	12.0	10.6	4.4	37.5	17.7	(1)
Location: sec. 16, T. 102 N., R. 49 W., 510 feet W. 30 feet S. of NE. corner.	A12p	4–9½	4.0	15.6	12.2	7.8	6.8	35.6	18.0	(1)
Survey No. S57SD–50–1–(1–9)	B1	9½–15	3.8	16.9	13.2	12.3	3.6	31.5	18.7	(1)
Laboratory No. 6165–6173	B21	15–19	4.0	17.5	14.6	13.9	5.1	28.1	16.8	(1)
	B22	19–26	7.6	23.9	18.0	16.7	6.5	17.0	10.3	(1)
	B31	26–33	10.9	30.7	20.6	14.4	5.5	13.1	4.8	1.4
	B32	33–38	16.1	27.9	21.1	14.7	4.8	9.5	5.9	4.3
	C1ca	38–52	22.7	32.1	19.8	11.0	2.9	7.9	3.6	4.2
	C2ca	52–67	17.0	32.6	23.8	14.6	2.4	6.2	3.4	5.1
Egeland loam.	A1p	0–7	1.2	15.4	11.8	12.8	7.8	34.8	16.2	--------
Location: sec. 17, T. 104 N., R. 49 W., 0.25 mile S. 50 feet E. of old stone quarry.	B1	7–12	1.3	18.2	14.1	14.0	8.6	27.8	16.0	--------
Survey No. S57SD–50–10–(1–8)	B21	12–19	2.1	23.6	17.9	16.1	8.7	19.6	12.0	--------
Laboratory No. 6247–6254	B22	19–25	2.0	22.4	17.9	17.5	10.0	19.7	10.5	--------
	B23	25–31	1.6	21.8	16.8	17.8	11.8	19.7	10.5	--------
	B31ca	31–39	2.1	20.0	13.3	13.9	13.1	26.8	10.8	(1)
	B32ca	39–47	2.4	15.4	13.4	17.2	15.3	25.7	10.6	(1)
	Cca	47–60+	3.8	14.9	11.2	14.8	17.1	27.2	11.0	(1)
Estelline silt loam.	A1p	0–7	3.4	7.5	4.8	4.4	3.6	51.8	24.5	1.2
Location: sec. 4, T. 104 N., R. 50 W., 105 feet E. and 395 feet S. of the center of the section.	B1	7–14	2.3	8.2	5.4	4.1	2.5	51.3	26.2	1.0
Survey No. S56SD–50–12–(1–9)	B21	14–19	1.8	6.8	4.4	3.6	2.3	54.9	26.2	.8
Laboratory No. 4634–4642	B22	19–25	1.2	6.9	4.6	3.4	2.2	54.4	27.3	.5
	B31	25–31	2.0	10.6	9.0	6.4	4.2	44.9	22.9	(1)
	B32	31–38	1.8	9.0	9.7	11.1	7.6	41.9	18.9	--------
	B3ca	38–42	2.0	6.2	6.1	5.7	7.4	53.8	18.8	--------
	CDca	42–47	9.2	12.2	12.3	19.8	10.2	24.7	11.6	22.3
	Dca	47–60	14.8	36.4	24.7	11.7	1.9	6.7	3.8	14.7
Flandreau loam.	A1p	0–7	1.6	11.5	10.8	9.0	4.7	43.5	18.9	--------
Location: sec. 5, T. 103 N., R. 49 W., 90 feet E. and 0.55 mile N. of the north-south road ¼ mile W. of SE. corner.	B1	7–13	1.4	9.6	8.2	6.0	3.6	49.9	21.3	--------
Survey No. S56SD–50–11–(1–9)	B21	13–19	.8	7.8	7.0	5.4	3.4	53.5	22.1	--------
Laboratory No. 4625–4633	B22	19–25	.8	5.7	4.7	3.5	3.1	55.6	26.6	--------
	B23	25–32	1.4	10.7	9.8	8.7	6.6	42.1	20.7	--------
	B3	32–36	4.0	15.3	11.8	13.3	8.8	31.5	15.3	--------
	D–B3	36–40	5.9	23.6	17.3	18.8	8.4	17.8	8.2	--------
	D1ca	40–52	4.8	25.4	23.4	20.7	7.0	13.0	5.7	--------
	D2ca	52–60	2.4	19.6	24.5	24.5	7.8	15.1	6.1	--------
Flandreau loam.	A1p	0–7	1.2	16.2	17.2	17.5	5.3	28.5	14.1	--------
Location: sec. 10, T. 103 N., R. 49 W., 120 feet N. and 0.075 mile E. of the SW. corner.	B1	7–17	.6	7.6	8.6	9.1	4.1	49.7	20.3	--------
Survey No. S56SD–50–19–(1–8)	B21	17–23	.2	2.8	3.2	3.5	3.1	59.4	27.8	--------
Laboratory No. 4695–4702	B22	23–28	.2	6.0	7.5	8.8	6.8	47.0	23.7	--------
	B3	28–33	1.2	14.7	18.3	20.5	10.1	23.1	12.1	--------
	D1	33–41	.6	19.0	25.8	26.0	7.0	13.9	7.7	--------
	D2	41–48	.5	16.4	23.8	21.7	9.4	19.6	8.6	--------
	Dca	48–60	.8	13.1	16.9	15.9	12.8	30.6	9.9	--------
Fordville loam.	A1p	0–8	2.3	11.8	7.0	4.8	1.6	46.5	26.0	.5
Location: sec. 5, T. 103 N., R. 50 W., 135 feet E. and 0.65 mile S. of the NW. corner.	B1	8–18	2.3	9.6	5.4	3.5	1.3	50.3	27.6	--------
Survey No. S56SD–50–8–(1–7)	B21	18–23	2.8	9.9	5.4	3.1	1.3	50.8	26.7	(1)
Laboratory No. 4601–4607	B22	23–29	8.1	16.8	8.6	5.2	1.7	38.9	20.7	2.6
	B3ca	29–33	13.7	28.9	12.0	8.3	1.7	22.9	12.5	7.0
	D1ca	33–50	23.6	44.0	15.3	9.4	.9	4.3	2.5	10.9
	D2ca	50–60	24.1	38.2	21.6	7.4	1.0	5.1	2.6	17.5

See footnote at end of table.

selected soil profiles—Continued

Lincoln, Nebr. Dashes indicate values not determined or do not apply]

Textural class USDA	pH	Organic carbon	Calcium carbonate equivalent	Moisture held at— Tension of 1/10 atmosphere	Tension of 1/3 atmosphere	Tension of 15 atmospheres	Cation-exchange capacity (NH_4OA_c)	Extractable cations Ca	Mg	H	K	Base saturation	Calcium-magnesium ratio
		Percent	Percent	Percent	Percent	Percent	Meq./100 g. of soil	Meq./100 g. of soil	Meq./100 g. of soil	Meq./100 g. of soil	Meq./100 g. of soil	Percent	
Loam	7.1	2.19	------	32.7	18.1	8.7	20.3	16.1	3.6	2.5	0.4	99	4.5
Loam	7.4	2.16	------	32.1	18.0	9.3	19.9	15.8	3.3	2.5	.2	97	4.8
Loam	6.7	1.32	------	31.5	17.6	9.1	17.0	12.3	2.6	3.7	.2	89	4.7
Sandy loam	6.6	.70	------	26.1	15.0	7.3	14.2	10.6	2.2	2.9	.1	91	4.8
Coarse sandy loam	6.7	.41	------	15.2	8.9	4.4	8.8	5.6	1.5	1.6	.1	82	3.7
Loamy coarse sand	7.1	.21	------	12.4	5.6	2.9	6.5	9.5	2.1	1.2	.2	100	4.5
Loamy coarse sand	7.6	.22	------	8.5	4.9	2.7	4.8	5.1	.9	.8	.1	100	5.7
Coarse sand	8.5	.07	10	7.5	3.9	1.8	2.3	------	------	------	------	------	------
Coarse sand	8.6	.04	11	5.3	3.3	1.4	------	------	------	------	------	------	------
Loam	6.5	1.73	------	27.8	17.6	7.5	15.6	10.7	2.7	4.5	.3	88	4.0
Sandy loam	6.8	.92	------	22.3	14.8	7.3	14.2	9.9	2.5	2.9	.2	89	4.0
Coarse sandy loam	7.1	.46	------	13.8	10.1	5.8	10.2	7.4	2.1	2.1	.1	94	3.5
Sandy loam	7.1	.29	------	14.3	8.9	5.0	8.8	6.4	1.7	1.2	.1	94	3.8
Sandy loam	6.9	.22	------	14.3	9.0	4.8	8.5	6.4	1.7	1.2	.1	98	3.8
Sandy loam	8.4	.15	13	17.0	10.0	4.6	8.0	------	------	------	.1	------	------
Sandy loam	8.4	.10	12	18.4	10.3	4.6	7.6	------	------	------	.1	------	------
Sandy loam	8.3	.07	13	18.7	10.3	4.9	7.9	------	------	------	.1	------	------
Silt loam	5.6	2.49	------	36.0	23.3	11.2	22.6	12.9	4.0	9.6	.5	77	3.2
Silt loam	6.2	1.75	------	35.3	24.5	12.2	22.3	14.6	4.8	6.7	.3	89	3.0
Silt loam	6.5	1.19	------	32.0	23.3	11.4	22.2	15.1	5.7	4.6	.3	95	2.6
Silty clay loam	6.7	.84	------	30.6	23.1	11.7	22.3	15.2	6.4	3.4	.3	99	2.4
Loam	6.8	.43	------	28.7	19.5	9.8	18.5	13.2	5.5	2.5	.2	100	2.4
Loam	7.6	.31	1	27.1	16.6	8.0	15.9	13.3	4.8	1.3	.2	100	2.8
Silt loam	8.1	.28	11	31.3	19.1	7.7	14.9	------	------	------	.3	------	------
Sandy loam	8.2	.15	13	15.5	9.7	5.0	8.6	------	------	------	.2	------	------
Coarse sand	8.4	.04	12	5.0	3.4	2.1	2.9	------	------	------	.1	------	------
Loam	6.5	2.05	------	30.2	19.4	9.0	17.6	13.0	3.4	4.6	.3	95	3.8
Loam	6.3	1.37	------	31.8	20.7	9.4	17.5	12.5	3.4	5.4	.2	93	3.7
Silt loam	6.5	.95	------	31.2	21.2	9.0	17.2	12.6	4.0	3.8	.2	98	3.2
Silt loam	6.5	.72	------	31.6	23.6	11.4	20.2	15.0	5.1	3.4	.2	100	2.9
Loam	6.6	.43	------	25.1	18.2	9.1	16.3	11.9	4.0	2.5	.2	99	3.0
Sandy loam	6.7	.32	------	20.2	12.8	6.7	12.2	9.3	3.2	1.7	.2	100	2.9
Coarse sandy loam	8.0	.16	4	10.7	6.0	3.4	5.9	12.1	1.4	.4	.1	100	8.6
Loamy coarse sand	8.4	.06	9	8.1	4.7	2.5	3.8	------	------	------	.1	------	------
Loamy sand	8.3	.05	10	8.9	5.9	3.2	4.6	------	------	------	.1	------	------
Loam	5.8	1.70	------	26.1	15.5	7.1	14.0	8.9	2.6	5.0	.4	85	3.4
Loam	6.1	.96	------	28.4	19.5	8.4	16.2	10.7	4.0	4.6	.2	92	2.7
Silty clay loam	6.5	.66	------	34.0	25.5	11.2	21.0	14.5	6.1	3.8	.3	100	2.4
Loam	6.7	.45	------	29.7	21.2	9.4	17.4	12.0	5.0	2.5	.2	99	2.4
Sandy loam	6.9	.20	------	16.0	10.4	5.0	9.6	6.9	2.7	1.2	.2	100	2.6
Loamy sand	7.1	.12	------	9.8	7.2	3.8	6.6	4.6	1.7	.8	.1	98	2.7
Sandy loam	7.4	.12	1	12.8	8.4	4.0	7.5	7.0	2.2	.8	.2	100	3.2
Sandy loam	8.0	.05	9	15.8	10.0	4.4	8.1	------	------	------	------	------	------
Loam	6.6	2.72	------	31.6	25.1	11.8	23.8	17.4	5.6	6.3	.4	99	3.1
Clay loam	7.2	1.55	------	31.9	26.3	12.3	24.4	18.7	6.2	4.2	.2	100	3.0
Silt loam	7.6	.92	------	26.0	23.3	11.7	21.9	17.3	6.4	2.5	.2	100	2.7
Loam	7.8	.62	------	22.2	19.1	9.1	17.9	14.2	5.2	1.7	.2	100	2.7
Coarse sandy loam	8.1	.40	6	13.9	11.1	5.9	10.3	------	------	------	.1	------	------
Coarse sand	8.4	.04	10	3.6	3.2	2.1	2.3	------	------	------	------	------	------
Coarse sand	8.5	.01	11	3.4	3.8	2.4	3.4	------	------	------	.1	------	------

TABLE 7.—*Analytical data for*

[Analyses made at Soil Survey Laboratory, Soil Conservation Service,

Soil	Horizon	Depth	Particle-size distribution: Very coarse sand (2 to 1 mm.)	Coarse sand (1 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (smaller than 0.002 mm.)	Course frag-ments (larger than 2 mm.)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Hidewood silty clay loam.	A1p	0-6	0. 1		0. 1	0. 1	2. 8	66. 1	30. 8	
Location: sec. 27, T. 103 N.,	A12	6-9					2. 4	66. 7	30. 9	
R. 47 W., 250 feet W. and	B1	9-16½			. 1	. 2	2. 7	65. 9	31. 1	
0.3 mile N. of the SE.	B21	16½-22		. 2	. 2	. 3	2. 4	66. 8	30. 1	
corner.	B22	22-29	. 3	. 5	. 3	. 5	1. 8	67. 4	29. 2	
Survey No. S56SD-50-16-	Ab	29-36	. 3	. 6	. 4	. 5	1. 4	67. 4	29. 4	
(1-9)	B1b	36-43	. 1	. 4	. 3	. 4	1. 0	66. 9	30. 9	
Laboratory No. 4669-4677	B2b	43-48		. 2	. 2	. 2	1. 0	60. 1	38. 3	
	B3b	48-60		. 1	. 1	. 1	1. 4	66. 1	32. 2	
Kranzburg silty clay loam.	A1p	0-4	. 3	1. 7	1. 6	2. 5	3. 5	57. 3	33. 1	
Location: sec. 20, T. 104	B21	4-10	. 1	. 3	. 3	. 6	2. 0	61. 3	35. 4	
N., R. 52 W., 140 feet W.	B22	10-17	. 1	. 1	. 1	. 3	3. 8	62. 1	33. 5	
200 feet N. of E¼ corner.	B23	17-29	. 1	. 2	. 3	. 9	3. 2	65. 7	29. 6	
Survey No. S56SD-502-(1-	B3ca	29-34	. 3	1. 7	2. 2	5. 5	4. 8	60. 5	25. 0	
8)	D-B3ca	34-41	2. 3	8. 8	9. 0	19. 5	8. 2	34. 6	17. 6	2. 4
Laboratory No. 4552-4559	D1ca	41-53	4. 9	10. 3	9. 2	20. 8	9. 6	26. 4	18. 8	6. 1
	D2ca	53-60	7. 0	9. 4	7. 3	13. 9	9. 3	31. 6	21. 5	6. 7
Kranzburg silty clay loam.	A1p	0-5	. 3	1. 0	. 9	2. 2	2. 9	61. 0	31. 7	
Location: sec. 10, T. 102	B22	5-10	. 1	. 2	. 3	. 7	1. 8	64. 4	32. 5	
N., R. 51 W., 0.45 mile N.	B22	10-17	. 1	. 1	. 1	. 3	2. 0	64. 2	33. 2	
and 150 feet W. of the S¼	B23	17-24			. 1	. 4	3. 3	64. 7	31. 5	
corner.	B24	24-27	. 1	. 1	. 2	. 6	3. 2	67. 0	28. 8	
Survey No. S56SD-50-6-	B3ca	27-35	1. 0	1. 4	1. 6	3. 6	4. 1	62. 9	25. 4	
(1-9)	B3-Dca	35-41	2. 3	4. 9	4. 2	9. 8	7. 6	40. 2	31. 0	4. 8
Laboratory No. 4583-4591	D1ca	41-50	2. 9	5. 3	4. 3	10. 7	8. 4	36. 4	32. 0	4. 7
	D2ca	50-60	3. 7	5. 3	4. 9	10. 4	8. 6	36. 2	30. 9	6. 0
Kranzburg silty clay loam.	A1p	0-5	. 5	1. 1	1. 2	2. 8	3. 4	58. 1	32. 9	
Location: sec. 5, T. 104 N.,	B1	5-12	. 1	. 3	. 4	. 8	2. 6	62. 5	33. 3	
R. 52 W., 230 feet N., 0.3	B21	12-21½	. 3	. 6	. 6	1. 5	4. 6	62. 5	29. 9	
mile E. of the SE. corner.	B22ca	21½-28	1. 0	1. 2	1. 7	4. 4	5. 3	60. 9	25. 5	1. 3
Survey No. S56SD-50-3-	B23ca-D	28-38	2. 2	4. 6	4. 8	10. 5	8. 4	39. 3	30. 2	4. 6
(1-8)	B24-Dca	38-46	3. 1	5. 8	5. 2	11. 1	8. 4	35. 8	30. 6	4. 7
Laboratory No. 4560-4567	B3-Dca	46-53	3. 9	6. 5	5. 3	10. 9	8. 3	34. 9	30. 2	4. 8
	C-Dca	53-60	4. 1	6. 0	4. 8	11. 3	8. 5	35. 3	30. 0	4. 9
Kranzburg silty clay loam.	A1p	0-6	. 3	1. 1	1. 2	2. 1	3. 1	62. 5	29. 7	
Location: sec. 32, T. 103	B1	6-10		. 6	. 6	1. 0	2. 3	65. 3	30. 2	
N., R. 51 W., 250 feet S.	Alb	10-18	. 1	. 4	. 3	. 5	1. 8	65. 3	31. 6	
and 95 feet E. of the N¼	B21	18-24		. 2	. 2	. 3	2. 0	66. 3	31. 0	
corner.	B22	24-31	. 1	. 1	. 1	. 3	3. 0	66. 3	30. 1	
Survey No. S56SD-50-7-	B23	31-34	. 1	. 1	. 2	. 7	2. 8	68. 4	27. 7	
(1-9)	DB3ca	34-40	. 3	. 7	. 7	1. 8	3. 1	67. 6	25. 8	
Laboratory No. 4592-4600	D1ca	40-47	3. 3	6. 0	4. 7	11. 4	8. 6	37. 5	28. 5	5. 9
	D2ca	47-60	4. 6	5. 8	4. 8	11. 4	8. 7	35. 0	29. 7	5. 1
La Prairie silt loam.	A1p	0-8	. 2	1. 2	3. 7	11. 1	8. 2	53. 2	22. 4	
Location: sec. 15, T. 101 N.,	B1	8-16	. 1	1. 2	4. 6	13. 1	8. 4	51. 2	21. 4	
R. 48 W., 320 feet W. and	B21	16-23	. 2	1. 2	3. 9	14. 1	8. 6	61. 4	20. 6	
55 feet S. of Beaver Creek	B22	23-29	. 1	1. 0	3. 5	16. 7	9. 5	50. 1	19. 1	([1])
bridge on the N. road.	B23	29-36	. 1	. 7	2. 5	15. 6	9. 9	53. 0	18. 2	
Survey No. S57SD-50-5-(1-	B24	36-42		1. 6	4. 6	15. 2	10. 9	50. 9	16. 8	
10)	B3	42-47	. 2	6. 4	14. 9	22. 7	6. 6	36. 3	12. 9	
Laboratory No. 6201-6210	C	47-52	. 2	6. 2	20. 0	34. 3	6. 0	23. 8	9. 5	([1])
	Cgca	52-59		. 8	3. 6	34. 9	10. 3	35. 9	14. 5	
	Cgca-Alb	59-68		. 4	3. 1	16. 9	6. 0	53. 0	20. 6	

See footnote at end of table.

selected soil profiles—Continued

Lincoln, Nebr. Dashes indicate values not determined or do not apply]

Textural class USDA	pH	Organic carbon	Calcium carbonate equivalent	Moisture held at— Tension of 1/10 atmosphere	Moisture held at— Tension of 1/3 atmosphere	Moisture held at— Tension of 15 atmospheres	Cation-exchange capacity (NH_4OA_c)	Extractable cations Ca	Extractable cations Mg	Extractable cations H	Extractable cations K	Base saturation	Calcium-magnesium ratio
		Percent	Percent	Percent	Percent	Percent	Meq./100 g. of soil	Meq./100 g. of soil	Meq./100 g. of soil	Meq./100 g. of soil	Meq./100 g. of soil	Percent	
Silty clay loam	5.6	3.53	--	33.9	31.0	14.4	28.7	17.9	4.9	10.6	1.1	83	3.6
Silty clay loam	5.7	3.47	--	39.2	34.6	14.7	28.9	19.1	5.4	10.1	.6	87	3.5
Silty clay loam	5.8	3.57	--	38.3	34.9	15.5	30.5	21.1	5.9	8.9	.5	91	3.6
Silty clay loam	6.1	2.36	--	33.5	31.1	14.4	26.9	18.1	5.9	6.8	.5	91	3.1
Silty clay loam	6.1	1.25	--	33.2	30.3	12.9	22.9	15.4	5.7	6.3	.6	95	2.7
Silty clay loam	6.1	1.13	--	31.3	29.2	13.2	23.8	15.5	6.2	6.3	.6	94	2.5
Silty clay loam	6.0	1.10		31.8	30.4	13.6	24.3	17.6	8.7	5.9	.6	100	2.0
Silty clay loam	5.8	.61	--	35.3	33.5	16.3	28.2	17.8	6.9	5.1	.6	90	2.6
Silty clay loam	6.1	.32	--	35.4	33.1	14.6	23.2	14.7	7.5	3.8	.5	99	2.0
Silty clay loam	6.1	3.63	--	43.0	29.4	14.9	28.3	17.5	7.0	8.5	.8	90	2.5
Silty clay loam	5.9	1.75	--	41.2	28.8	14.7	27.5	15.9	8.9	7.2	.3	92	1.8
Silty clay loam	6.5	.78	--	36.4	27.6	13.8	26.7	15.2	10.9	6.0	.3	99	1.4
Silty clay loam	7.3	.50	--	37.9	26.6	12.2	24.3	15.1	10.6	1.7	.3	100	1.4
Silt loam	8.1	.28	8	31.0	24.5	9.8	18.9	--	--	--	.3	--	--
Loam	8.4	.15	8	19.9	15.8	6.7	12.9	--	--	--	.2	--	--
Fine sandy loam	8.5	.14	16	19.2	15.7	7.1	11.1	--	--	--	.2	--	--
Loam	8.5	.14	14	22.3	18.4	8.7	11.8	--	--	--	.2	--	--
Silty clay loam	6.0	3.08	--	43.5	31.7	14.3	26.8	16.0	5.9	9.7	1.2	87	2.7
Silty clay loam	6.1	1.48	--	38.3	29.2	13.8	25.2	14.9	7.8	7.2	.4	92	1.9
Silty clay loam	6.6	.85	--	37.3	27.7	13.5	26.0	15.3	8.7	4.2	.3	94	1.8
Silty clay loam	6.8	.56	--	35.7	26.8	12.8	25.5	15.3	10.2	3.0	.3	100	1.5
Silty clay loam	7.4	.43	1	40.6	30.0	12.3	24.2	15.7	10.1	2.5	.3	100	1.6
Silt loam	8.2	.30	11	36.2	26.7	10.4	21.1	--	--	--	.3	--	--
Clay loam	8.2	.18	16	30.0	23.1	10.9	23.4	--	--	--	.3	--	--
Clay loam	8.3	.14	16	30.8	22.9	12.0	19.7	--	--	--	.3	--	--
Clay loam	8.3	.16	17	29.6	22.5	12.0	16.6	--	--	--	.3	--	--
Silty clay loam	6.0	2.76	--	37.8	31.3	13.9	26.5	16.4	6.0	9.5	.7	87	2.7
Silty clay loam	6.7	1.22	--	32.4	28.4	14.3	25.2	16.0	8.0	7.7	.3	97	2.0
Silty clay loam	7.3	.69	--	30.8	26.7	12.7	23.7	16.4	8.8	3.0	.3	100	1.9
Silt loam	8.2	.40	14	28.7	24.5	10.6	17.2	--	--	--	.2	--	--
Clay loam	8.2	.19	19	24.4	21.2	10.6	15.0	--	--	--	.2	--	--
Clay loam	8.2	.11	19	25.0	21.8	11.2	14.4	--	--	--	.2	--	--
Clay loam	8.4	.15	20	25.4	22.2	11.7	13.8	--	--	--	.2	--	--
Clay loam	8.4	.14	19	26.3	23.1	11.7	13.7	--	--	--	.2	--	--
Silty clay loam	5.8	3.44	--	36.1	29.1	13.6	28.0	15.9	5.8	10.6	.5	80	2.7
Silty clay loam	6.1	1.92	--	34.8	28.3	12.9	24.1	12.9	7.1	8.4	.4	85	1.8
Silty clay loam	6.3	1.32	--	32.5	27.5	12.9	25.1	13.1	9.1	6.8	.3	90	1.4
Silty clay loam	6.2	.83	--	31.8	27.6	12.7	25.7	13.5	11.0	5.5	.3	97	1.2
Silty clay loam	6.2	.54	--	31.4	27.3	12.5	25.0	12.9	11.2	4.2	.3	98	1.2
Silty clay loam	7.8	.38	2	33.2	31.9	11.9	23.3	16.4	12.0	1.7	.3	100	1.4
Silt loam	8.2	.26	10	31.8	27.5	11.0	19.5	--	--	--	.3	--	--
Clay loam	8.2	.16	16	24.8	22.1	10.5	16.8	--	--	--	.3	--	--
Clay loam	8.3	.11	16	26.0	23.6	11.6	16.1	--	--	--	.3	--	--
Silt loam	6.0	2.79	--	38.0	26.8	11.8	24.8	16.0	3.7	8.8	.9	83	4.3
Silt loam	6.6	1.94	--	33.6	24.2	11.4	21.9	16.6	3.4	4.6	.4	93	4.9
Silt loam	6.7	1.51	--	38.1	23.5	10.4	20.5	15.8	3.2	2.9	.4	95	4.9
Silt loam	7.0	1.06	--	36.8	21.2	9.1	18.1	13.8	3.2	2.5	.3	96	4.3
Silt loam	7.4	.71	--	34.7	20.6	8.4	17.1	13.6	3.3	2.1	.3	100	4.1
Silt loam	7.5	.53	1	33.5	19.5	7.8	15.9	12.7	2.9	1.7	.2	99	4.4
Loam	7.6	.34	--	28.4	15.1	5.7	12.0	9.9	2.5	.8	.2	100	4.0
Sandy loam	8.0	.19	2	21.2	10.7	4.6	8.8	8.4	1.6	.8	.2	100	5.2
Loam	8.3	.32	3	30.4	17.0	6.9	12.4	--	--	--	.2	--	--
Silt loam	8.2	.46	5	37.9	25.4	10.3	17.7	--	--	--	.3	--	--

TABLE 7.—*Analytical data for*

[Analyses made at Soil Survey Laboratory, Soil Conservation Service,

Soil	Horizon	Depth	Particle-size distribution: Very coarse sand (2 to 1 mm.)	Coarse sand (1 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (smaller than 0.002 mm.)	Course fragments (larger than 2 mm.)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percen*	*Percent*	*Percent*	*Percent*
La Prairie silt loam.	A1p	0–7	0.4	3.1	4.8	9.4	6.5	50.0	25.8	([1])
Location: sec. 10, T. 102 N.,	B1	7–12	.2	2.6	4.9	10.4	8.4	49.5	24.0	([1])
R. 48 W., 0.25 mile and	B21	12–22	.2	2.5	4.8	12.0	9.7	48.1	22.7	([1])
0.5 mile W. of the NE.	B22	22–29	.5	3.2	6.1	14.4	10.9	45.4	19.5	([1])
corner.	B23	29–35	2.1	5.0	10.1	18.4	10.2	38.1	16.1	1.7
Survey No. S57SD–50–8–(1–	B31	35–40	.2	3.6	8.1	19.8	11.3	40.3	16.7	([1])
9)	B32ca	40–45	.4	7.5	13.0	15.1	9.5	37.5	17.0	([1])
Laboratory No. 6229–6237	B33ca	45–57	.8	8.7	12.0	15.8	9.1	37.5	16.1	([1])
	Cca	57–62+	.9	15.4	22.0	26.6	5.5	19.5	10.1	--------
Luton clay.	A1p	0–6	.1	.2	.4	1.1	2.0	53.9	42.3	--------
Location: sec. 6, T. 103 N.,	A1	6–10	--------	.2	.3	1.0	2.4	52.1	44.0	--------
R. 49 W., 105 feet W. and	AC1	10–17	--------	.3	.6	1.7	3.2	52.2	42.0	--------
0.2 mile N. of S¼ corner.	AC2	17–27	.3	.7	.7	1.9	3.9	53.2	39.3	--------
Survey No. S56SD–50–9–	C1	27–35	.6	.5	.6	1.7	4.1	54.3	38.2	--------
(1–9)	Cg	35–41	.5	.3	.3	1.4	4.5	59.5	33.5	--------
Laboratory No. 4608–4616	C3ca	41–46	.8	.7	.3	1.5	6.3	61.3	29.1	--------
	C4ca	46–59	1.5	.4	.2	2.0	4.6	59.4	31.9	--------
	C5ca	59–65	.6	.5	.3	.7	1.4	66.8	29.7	--------
Luton clay.	A1p	0–7	.1	.2	.2	1.2	2.4	52.2	43.7	--------
Location: sec. 20, T. 103 N.,	A1	7–17	--------	.2	.2	1.8	3.4	51.2	43.2	--------
R. 49 W. 230 feet S. and	C1	17–26	--------	.2	.4	2.3	3.9	51.1	42.1	--------
230 feet W. of E¼ corner.	C1g	26–33	--------	.2	.4	2.6	4.9	53.3	38.6	--------
Survey No. S56SD–50–10–	C2	33–44	--------	.1	.4	4.4	5.7	52.4	37.0	--------
(1–8)	C2ca	44–49	2.0	1.0	.6	7.1	7.7	52.5	29.1	--------
Laboratory No. 4617–4624	C3ca	49–54	2.6	1.4	.7	8.5	6.0	55.9	24.9	--------
	C4ca	54–60	.9	.6	.4	2.7	6.7	61.3	27.4	--------
Moody silty clay loam.	A1p	0–5	.1	.3	.4	.7	2.4	65.1	31.0	--------
Location: sec. 19, T. 102 N.,	B1	5–9½	--------	.2	.2	.4	1.9	66.0	31.3	--------
R. 47 W., 0.35 mile W.	B21	9½–15	--------	.1	.1	.3	1.9	65.8	31.8	--------
and 90 feet S. of the NE.	B22	15–23	--------	--------	.1	.4	2.7	64.3	32.5	--------
corner.	B23	23–30	--------	.1	.1	.3	4.0	65.9	29.6	--------
Survey No. S56SD–50–14–	B24	30–36	--------	.1	.1	.6	5.9	68.2	25.1	--------
(1–9)	D1ca	36–45	.3	.5	.6	.7	4.3	72.7	20.9	--------
Laboratory No. 4651–4659	D2ca	45–52	.1	.9	1.6	1.6	8.3	69.0	18.5	--------
	D3ca	52–60	.2	1.3	1.9	2.0	7.7	67.8	19.1	--------
Moody silty clay loam.	ABp	0–7	.1	.1	.2	.6	5.2	63.2	30.6	--------
Location: sec. 5, T. 101 N.,	B21	7–11	--------	--------	--------	.5	4.7	61.8	33.0	--------
R. 48 W., 400 feet N. and	B22	11–17	--------	--------	--------	.4	5.6	62.6	31.4	--------
245 feet E. of SW. corner.	B23	17–22	--------	--------	--------	.4	8.9	65.1	25.6	--------
Survey No. S56SD–50–17–	B24	22–30	--------	--------	--------	.5	13.4	66.7	19.4	--------
(1–8)	B3ca	30–42	.1	--------	--------	.4	16.3	67.4	15.8	--------
Laboratory No. 4678–4685	C1ca	42–56	--------	--------	--------	.3	17.8	65.8	16.1	--------
	C2ca	56–60	.1	.1	.1	.4	9.0	73.7	16.6	--------
Nora silt loam.	ABp	0–5	.3	.2	.3	.9	8.4	63.1	26.8	([1])
Location: sec. 5, T. 102 N.,	B21	5–12	.1	.1	.2	.7	10.0	63.1	25.8	([1])
R. 48 W., 400 feet N. and	B22	12–18	.1	.1	.2	.9	11.1	63.2	24.4	--------
85 feet E. of the SW.	B23ca	18–24	.2	.2	.3	1.1	12.5	66.5	19.2	([1])
corner.	B24ca	24–31	.3	.2	.4	1.4	14.4	65.0	18.3	([1])
Survey No. S57SD–50–4–(1–	B25ca	31–38	.1	.2	.4	1.4	14.1	64.3	19.5	([1])
9)	B31ca	38–45	.2	.2	.4	1.2	14.6	65.1	18.3	([1])
Laboratory No. 6192–6200	B32ca	45–55	.1	.2	.2	.8	12.7	67.3	18.7	([1])
	Cca	55–67+	--------	.2	.1	.8	17.4	63.9	17.6	--------

See footnote at end of table.

selected soil profiles—Continued

Lincoln, Nebr. Dashes indicate values not determined or do not apply]

Textural class USDA	pH	Organic carbon	Calcium carbonate equivalent	Moisture held at— Tension of 1/10 atmosphere	Moisture held at— Tension of 1/3 atmosphere	Moisture held at— Tension of 15 atmospheres	Cation-exchange capacity (NH_4OAc)	Extractable cations Ca	Extractable cations Mg	Extractable cations H	Extractable cations K	Base saturation	Calcium-magnesium ratio
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Percent*	
Silt loam	6. 3	2. 84	--------	42. 6	26. 2	11. 9	27. 8	19. 3	4. 4	9. 6	0. 4	87	4. 4
Loam	6. 5	2. 24	--------	44. 5	24. 6	11. 2	25. 7	18. 6	4. 3	5. 8	. 2	90	4. 3
Loam	6. 8	1. 34	--------	38. 3	22. 9	10. 0	22. 7	17. 4	4. 0	4. 2	. 2	96	4. 4
Loam	7. 0	. 83	--------	33. 4	20. 0	9. 0	19. 4	15. 2	3. 6	2. 5	. 2	98	4. 2
Loam	7. 3	. 58	--------	27. 6	16. 0	7. 3	15. 7	12. 8	2. 6	1. 2	. 2	100	4. 9
Loam	8. 0	. 50	2	26. 2	17. 0	7. 5	16. 0	21. 2	2. 7	. 4	. 2	100	7. 8
Loam	8. 2	. 46	7	25. 9	16. 7	7. 6	13. 4	------	------	------	. 2	------	--------
Loam	8. 3	. 37	8	26. 4	16. 7	7. 7	12. 4	------	------	------	. 2	------	--------
Sandy loam	8. 5	. 17	11	15. 9	10. 0	4. 4	8. 1	------	------	------	. 1	------	--------
Silty clay	6. 5	2. 85	--------	41. 8	35. 4	19. 6	43. 6	32. 0	12. 5	5. 2	. 5	100	2. 6
Silty clay	6. 8	2. 51	--------	42. 3	36. 0	20. 0	44. 6	33. 6	14. 1	3. 9	. 4	100	2. 4
Silty clay	7. 2	1. 44	1	43. 1	33. 4	19. 0	39. 3	29. 8	12. 0	2. 6	. 4	100	2. 5
Silty clay loam	7. 8	. 97	1	38. 8	31. 2	17. 0	34. 1	28. 3	11. 3	1. 7	. 3	100	2. 5
Silty clay loam	8. 0	. 76	1	37. 5	30. 5	16. 2	32. 3	26. 4	11. 3	. 9	. 3	100	2. 3
Silty clay loam	8. 1	. 59	2	37. 8	29. 8	14. 6	27. 7	26. 3	10. 2	. 4	. 3	100	2. 6
Silty clay loam	7. 2	. 42	14	39. 1	29. 3	12. 6	21. 8	------	------	------	. 3	------	--------
Silty clay loam	8. 1	. 42	9	39. 7	30. 9	14. 0	25. 1	------	------	------	. 3	------	--------
Silty clay loam	8. 1	. 37	10	40. 0	31. 2	13. 5	23. 0	------	------	------	. 4	------	--------
Silty clay	5. 8	3. 06	--------	47. 3	36. 2	19. 5	40. 9	30. 7	9. 7	9. 2	. 4	100	3. 2
Silty clay	6. 3	2. 18	1	43. 9	34. 9	20. 3	40. 7	31. 9	9. 0	6. 5	. 3	100	3. 5
Silty clay	6. 8	1. 38	1	42. 0	33. 6	19. 2	38. 8	30. 6	8. 9	4. 8	. 2	100	3. 4
Silty clay loam	6. 9	. 97	1	40. 8	31. 6	17. 0	35. 0	29. 7	8. 4	3. 5	. 3	100	3. 5
Silty clay loam	6. 8	. 77	1	40. 2	31. 0	16. 0	33. 1	27. 0	7. 8	2. 6	. 3	100	3. 5
Silty clay loam	7. 9	. 57	18	37. 3	28. 8	12. 2	22. 6	------	------	------	. 2	------	--------
Silt loam	8. 0	. 39	19	36. 3	23. 7	10. 8	18. 4	------	------	------	. 2	------	--------
Silty clay loam	7. 9	. 40	14	37. 7	29. 5	12. 4	21. 3	------	------	------	. 3	------	--------
Silty clay loam	5. 8	3. 13	--------	48. 0	29. 4	14. 5	26. 4	16. 4	5. 8	9. 3	. 6	87	2. 8
Silty clay loam	5. 9	2. 43	--------	44. 9	29. 8	15. 0	25. 4	15. 5	6. 7	8. 9	. 4	89	2. 3
Silty clay loam	6. 1	1. 42	--------	39. 2	27. 9	14. 1	24. 3	16. 7	7. 3	6. 3	. 3	100	2. 3
Silty clay loam	6. 2	. 75	--------	36. 0	27. 0	14. 4	25. 1	15. 6	8. 8	4. 2	. 4	99	1. 8
Silty clay loam	6. 5	. 47	--------	36. 3	26. 9	12. 8	22. 9	14. 7	8. 2	3. 8	. 3	100	1. 8
Silt loam	6. 5	. 37	--------	38. 6	25. 1	11. 2	20. 2	13. 8	7. 3	2. 5	. 3	100	1. 9
Silt loam	8. 0	. 26	8	38. 6	24. 9	8. 9	16. 2	------	------	------	. 3	------	--------
Silt loam	8. 1	. 18	11	37. 1	23. 1	8. 2	15. 3	------	------	------	. 3	------	--------
Silt loam	8. 1	. 17	10	36. 8	24. 3	8. 6	15. 8	------	------	------	. 3	------	--------
Silty clay loam	5. 7	2. 55	--------	30. 2	28. 1	13. 6	25. 8	16. 2	7. 0	8. 0	. 4	92	2. 3
Silty clay loam	6. 1	1. 14	--------	29. 0	27. 5	13. 9	26. 7	17. 4	7. 8	5. 1	. 3	96	2. 2
Silty clay loam	6. 2	. 68	--------	27. 6	26. 0	12. 9	25. 5	16. 5	8. 1	3. 4	. 3	98	2. 0
Silt loam	6. 5	. 48	--------	26. 2	24. 3	10. 6	21. 1	13. 8	6. 9	2. 9	. 3	100	2. 0
Silt loam	6. 5	. 40	--------	35. 7	18. 5	8. 4	16. 8	11. 1	5. 4	2. 5	. 3	100	2. 0
Silt loam	8. 0	. 22	12	35. 5	16. 0	6. 6	13. 0	------	------	------	. 2	------	--------
Silt loam	8. 1	. 16	12	36. 4	16. 8	7. 0	13. 2	------	------	------	. 3	------	--------
Silt loam	8. 1	. 14	13	38. 7	20. 2	7. 6	13. 5	------	------	------	. 3	------	--------
Silt loam	7. 8	2. 26	--------	36. 2	25. 9	12. 3	25. 8	18. 3	5. 9	3. 0	. 4	95	3. 1
Silt loam	7. 9	1. 13	1	33. 7	23. 5	12. 0	22. 9	20. 6	6. 0	2. 1	. 3	100	3. 4
Silt loam	7. 9	. 66	1	32. 7	22. 3	11. 0	21. 6	18. 2	5. 9	1. 3	. 3	100	3. 1
Silt loam	8. 2	. 38	14	31. 2	19. 5	8. 5	16. 1	------	------	------	. 2	------	--------
Silt loam	8. 2	. 26	14	31. 8	18. 8	7. 9	14. 9	------	------	------	. 3	------	--------
Silt loam	8. 4	. 18	14	32. 8	19. 7	8. 6	15. 1	------	------	------	. 3	------	--------
Silt loam	8. 4	. 14	22	34. 4	18. 6	8. 3	14. 6	------	------	------	. 2	------	--------
Silt loam	8. 4	. 10	16	35. 2	19. 3	8. 3	14. 4	------	------	------	. 2	------	--------
Silt loam	8. 5	. 09	13	35. 5	18. 4	8. 2	14. 1	------	------	------	. 3	------	--------

TABLE 7.—*Analytical data for*

[Analyses made at Soil Survey Laboratory, Soil Conservation Service,

Soil	Horizon	Depth	Particle-size distribution							Course fragments (larger than 2 mm.)
			Very coarse sand (2 to 1 mm.)	Coarse sand (1 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)	Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay (smaller than 0.002 mm.)	
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Nora silt loam.	ABp	0–4	0. 2	0. 2	0. 2	0. 6	9. 9	65. 1	23. 8	
Location: sec. 6, T. 102 N.,	BAp	4–8		. 1	. 1	. 3	10. 3	65. 1	24. 1	
R. 47 W., 0.45 mile S. of	B2	8–14	. 1			. 1	6. 0	70. 5	23. 3	
the NE. corner and 65	B22ca	14–24	. 8	. 4	. 2	. 4	6. 5	72. 7	19. 0	1. 5
feet W. of blazed pole.	B23ca	24–30	. 4	. 1		. 3	7. 5	72. 9	18. 8	2. 0
Survey No. S57SD–50–9–(1–	B24ca	30–36	. 2	. 1		. 2	11. 4	69. 2	18. 9	1. 6
9)	B31ca	36–43	. 3	. 1		. 2	9. 5	69. 8	20. 1	[1]
Laboratory No. 6238–6246	B32ca	43–50	. 1	. 2		. 1	7. 3	72. 0	20. 3	
	Cca	50–60+				. 1	9. 5	70. 8	19. 6	
Sinai silty clay.	A1p	0–8	. 2	. 2	. 3	. 7	1. 3	51. 3	46. 0	
Location: sec. 19, T. 104	B21	8–19	. 1	. 1	. 1	. 3	1. 0	54. 0	44. 4	
N., R. 52 W., 175 feet S.	B22ca	19–28	. 1	. 1	. 1	. 3	2. 2	59. 8	37. 4	
and 370 feet W. of the NE.	B23ca	28–36			. 1	. 6	3. 5	60. 3	35. 5	
corner.	B24ca	36–44		. 1	. 1	. 4	2. 8	59. 5	37. 1	
Survey No. S56SD–50–4–	B31ca	44–50		. 1	. 1	. 5	2. 8	61. 1	35. 4	
(1–7)	B32ca	50–60	. 2	. 3	. 2	. 4	3. 9	60. 4	34. 6	
Laboratory No. 4568–4574										
Sinai silty clay.	A1p	0–6	. 3	. 5	. 5	1. 1	2. 2	55. 5	39. 9	
Location sec. 18, T. 103 N.,	B2	6–13		. 2	. 2	. 5	1. 1	57. 1	40. 9	
R. 52 W., 85 feet N. and	B21ca	13–17	. 6	. 5	. 2	. 6	1. 1	64. 2	32. 8	
0.25 mile E. of the SW.	B22ca	17–26	1. 0	. 5	. 2	. 4	1. 2	62. 7	34. 0	
corner.	B23ca	26–32	1. 3	. 5	. 2	. 5	1. 9	62. 3	33. 3	2. 7
Survey No. S56SD–50–5–	B2–B3ca	32–38	. 4	. 3	. 2	. 5	2. 0	62. 0	34. 6	
(1–8)	B31ca	38–47	. 2	. 1	. 1	. 4	1. 7	58. 6	38. 9	
Laboratory No. 4575–4582	B32ca	47–60	. 1	. 1	. 1	. 5	2. 4	56. 3	40. 5	
Trent silty clay loam.	A1p	0–8	. 1	. 2	. 2	. 5	3. 2	65. 4	30. 4	
Location: sec. 7, T. 104 N.,	A1	8–14	. 3	. 4	. 2	. 5	2. 9	64. 8	30. 9	
R. 48 W., 0.25 mile W. of	B1	14–20	. 3	. 5	. 2	. 3	2. 9	64. 8	31. 0	
the E. side of the middle	B21	20–26	. 2	. 4	. 2	. 3	2. 2	65. 6	31. 1	
of section.	B22	26–31	. 1	. 1	. 1	. 3	3. 0	66. 8	29. 6	
Survey No. S57SD–50–2–	B23	31–39		. 1	. 1	. 3	3. 4	67. 6	28. 5	
(1–9)	B31ca	39–47		. 2	. 2	. 6	9. 1	74. 6	15. 3	[1]
Laboratory No. 6174–6182	B32ca	47–53	. 1	. 2	. 2	. 6	9. 6	73. 2	16. 1	2. 7
	Cgca	53–60	. 1	. 1	. 1	. 5	8. 6	75. 6	15. 0	[1]
Trent silty clay loam.	A1p	0–6	. 2	. 2	. 2	. 5	2. 3	65. 3	31. 3	
Location: sec. 35, T. 104 N.,	A3	6–12	. 2	. 2	. 2	. 5	2. 6	64. 4	31. 9	
R. 48 W., 0.2 mile S. 100	B1	12–16	. 2	. 2	. 2	. 4	2. 2	64. 4	32. 4	
feet W. of NE. corner.	B21	16–25	. 1	. 3	. 2	. 4	1. 4	64. 3	33. 3	
Survey No. S57SD–50–3–	B22	25–31		. 1	. 2	. 3	2. 1	65. 0	32. 3	[1]
(1–9)	B23	31–39	. 1	. 1	. 2	. 6	3. 4	65. 8	29. 8	
Laboratory No. 6183–6191	B3	39–46			. 1	. 4	5. 2	68. 4	25. 9	
	B31gca	46–53	. 1	. 1	. 2	. 6	6. 6	71. 7	20. 7	[1]
	B32gca	53–60+		. 1	. 1	. 5	8. 8	71. 2	19. 3	

[1] Trace.

selected soil profiles—Continued

Lincoln, Nebr. Dashes indicate values not determined or do not apply]

Textural class USDA	pH	Organic carbon	Calcium carbonate equivalent	Moisture held at— Tension of 1/10 atmosphere	Tension of 1/3 atmosphere	Tension of 15 atmospheres	Cation-exchange capacity (NH_4OA_c)	Extractable cations Ca	Mg	H	K	Base saturation	Calcium-magnesium ratio
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Meq./100 g. of soil*	*Percent*	
Silt loam	7. 3	2. 20	--------	41. 6	21. 7	11. 1	23. 6	17. 9	5. 8	2. 1	0. 6	100	3. 1
Silt loam	7. 5	1. 62	--------	41. 1	21. 2	10. 4	22. 4	16. 6	5. 5	1. 2	. 3	100	3. 0
Silt loam	7. 8	. 77	--------	38. 0	21. 0	10. 1	20. 7	15. 8	5. 5	. 8	. 2	100	2. 9
Silt loam	8. 2	. 38	14	36. 3	19. 7	8. 8	16. 2	------	------	------	. 2	------	--------
Silt loam	8. 2	. 27	14	36. 4	18. 8	8. 4	15. 1	------	------	------	. 2	------	--------
Silt loam	8. 2	. 23	13	37. 6	19. 0	8. 5	15. 0	------	------	------	. 2	------	--------
Silt loam	8. 2	. 15	13	38. 9	20. 0	8. 8	15. 7	------	------	------	. 2	------	--------
Silt loam	8. 3	. 14	12	40. 6	22. 2	9. 4	16. 6	------	------	------	. 2	------	--------
Silt loam	8. 4	. 12	11	40. 3	26. 0	9. 6	16. 2	------	------	------	. 2	------	--------
Silty clay	6. 1	2. 26	--------	35. 6	30. 8	17. 6	31. 8	20. 3	9. 1	7. 8	. 8	95	2. 2
Silty clay	7. 2	1. 04	1	33. 3	29. 3	16. 6	30. 2	22. 2	10. 6	3. 9	. 5	100	2. 1
Silty clay loam	8. 2	. 46	19	31. 8	27. 6	13. 2	21. 4	------	------	------	. 4	------	--------
Silty clay loam	8. 2	. 32	18	34. 5	29. 9	13. 2	20. 4	------	------	------	. 4	------	--------
Silty clay loam	8. 1	. 25	17	36. 5	31. 5	15. 0	21. 2	------	------	------	. 3	------	--------
Silty clay loam	8. 2	. 24	16	37. 4	32. 0	15. 0	20. 7	------	------	------	. 4	------	--------
Silty clay loam	8. 3	. 22	16	39. 1	31. 6	15. 0	20. 3	------	------	------	. 4	------	--------
Silty clay	6. 2	3. 68	--------	44. 9	33. 5	17. 7	33. 5	24. 0	6. 2	8. 6	. 9	93	3. 9
Silty clay	6. 9	2. 41	1	43. 5	33. 2	18. 0	31. 6	28. 0	5. 9	5. 6	. 4	100	4. 7
Silty clay loam	8. 2	1. 48	18	36. 5	28. 6	14. 2	23. 3	------	------	------	. 3	------	--------
Silty clay loam	8. 0	. 75	20	34. 2	27. 0	13. 5	22. 0	------	------	------	. 3	------	--------
Silty clay loam	8. 0	. 48	17	37. 8	28. 6	13. 7	21. 7	------	------	------	. 3	------	--------
Silty clay loam	8. 1	. 30	18	37. 5	31. 2	14. 2	21. 4	------	------	------	. 4	------	--------
Silty clay loam	8. 2	. 29	18	40. 5	33. 4	16. 4	22. 6	------	------	------	. 4	------	--------
Silty clay	8. 0	. 31	16	40. 6	33. 3	17. 3	23. 2	------	------	------	. 5	------	--------
Silty clay loam	6. 7	3. 22	--------	47. 9	31. 4	14. 3	30. 4	20. 7	6. 4	6. 8	. 7	91	3. 2
Silty clay loam	6. 6	2. 21	--------	44. 5	30. 2	14. 7	27. 7	17. 7	6. 3	6. 9	. 3	88	2. 8
Silty clay loam	6. 6	1. 50	--------	40. 9	28. 3	14. 5	27. 7	17. 7	7. 2	5. 1	. 3	91	2. 4
Silty clay loam	6. 8	. 75	--------	38. 6	27. 7	13. 9	26. 6	17. 5	7. 5	3. 9	. 2	95	2. 3
Silty clay loam	6. 8	. 53	--------	39. 9	28. 2	13. 8	25. 0	17. 0	7. 5	2. 6	. 2	99	2. 3
Silty clay loam	7. 5	. 42	--------	43. 2	32. 6	13. 8	24. 4	17. 4	7. 3	2. 1	. 3	100	2. 4
Silt loam	8. 3	. 18	17	37. 2	21. 8	7. 4	12. 7	------	------	------	. 2	------	--------
Silt loam	8. 3	. 12	17	36. 6	22. 8	7. 9	12. 7	------	------	------	. 2	------	--------
Silt loam	8. 4	. 06	16	35. 6	22. 8	7. 2	12. 6	------	------	------	. 2	------	--------
Silty clay loam	5. 9	3. 56	--------	47. 0	30. 9	14. 5	30. 8	18. 9	5. 5	11. 1	1. 1	83	3. 4
Silty clay loam	6. 3	2. 78	--------	48. 6	32. 1	16. 2	28. 4	18. 0	5. 8	9. 5	. 5	86	3. 1
Silty clay loam	6. 5	1. 84	--------	38. 1	30. 0	14. 3	26. 6	16. 5	5. 9	7. 8	. 4	86	2. 8
Silty clay loam	6. 5	1. 14	--------	36. 6	29. 8	14. 4	26. 2	17. 1	6. 6	6. 4	. 5	93	2. 6
Silty clay loam	6. 6	. 63	--------	35. 3	28. 2	13. 9	25. 0	16. 9	6. 6	4. 7	. 4	96	2. 6
Silty clay loam	6. 6	. 49	--------	34. 7	28. 6	13. 4	23. 9	16. 6	7. 4	4. 2	. 4	100	2. 2
Silt loam	7. 3	. 35	--------	36. 3	27. 6	12. 0	21. 1	16. 1	5. 9	2. 1	. 3	100	2. 7
Silt loam	8. 2	. 15	12	34. 9	25. 1	9. 9	16. 7	------	------	------	. 3	------	--------
Silt loam	8. 3	. 10	11	34. 3	23. 9	9. 1	16. 2	------	------	------	. 2	------	--------

General Nature of the County

This section is provided mainly for those who are not familiar with Minnehaha County. It consists of general information about the county, some statistics on agriculture, and detailed information about the climate.

Climate [7]

The climate of Minnehaha County is continental. The summers are quite warm, and the winters are long and cold. Maximum precipitation occurs late in spring and in summer, and minimum precipitation is in winter. The weather changes frequently from day to day and from week to week. Air masses of different properties blow in and bring wide differences in temperature and other atmospheric conditions. Seasonal weather also varies widely from year to year, but there are times when hot weather in summer or very cold weather in winter lasts for several days or for more than a week. Listed in table 8 are temperature and precipitation data recorded at Sioux Falls.

Temperature

Temperature fluctuates frequently. Only a few times a year do extremes of temperature stay about the same for even a few days. Masses of cold air often move in rapidly and cause strong, gusty winds for several hours and a rapid fall in temperature. Late in fall, in winter, and early in spring, a cold front may lower the temperature from 20° to 30° F. within 24 hours or less.

The average daily temperature normally reaches its minimum of about 15° during January. There is noticeable warming by late February, and by about April 10 the normal daily average is near 45°.

During the first 10 days of May the average daily temperature is about 55°, and by June 20, it is about 70°. The daily average remains about 70° until late in August, but a maximum temperature of 88° may occur about the middle of July. The temperature drops rather slowly from a normal daily average of about 68° early in September to near 50° by the middle of October. Cooling takes place more rapidly after about October 15, and the daily average is 32° by the middle of November. The normal daily maximum temperature for the county is about 12° above the daily average; the normal daily minimum temperature is about 12° below the daily average.

A temperature of 90° or higher occurs on an average of 25 to 30 days per year. More than half of these days are in July and in August. Cool summers may have 15 days or less with a temperature of 90° or higher, and especially hot summers may have 40 or more. A temperature of 90° or higher generally occurs as early as the second or third week in May and as late as the first or second week in September. Normally, temperatures reach 100° or higher on 2 or 3 days per year, usually between July 1 and the early part of August. The frequency of 100° temperature in Minnehaha County is appreciably less than it is in the central and western counties of the State.

A temperature of 0° or colder occurs on an average of 30 days per winter. When winters are mild, there may be as few as 10 days of 0° temperature, but in severe winters the number may exceed 40 days. A temperature of 0° or colder may be expected as early as the middle of November and as late as the middle of March.

[7] By A. B. Pack, State climatologist, U.S. Weather Bureau, Huron, South Dak.

TABLE 8.—*Temperature and precipitation at Sioux Falls, Minnehaha County, South Dakota*

Month	Temperature				Precipitation							
			7 years in 10					3 years in 10 will have			Average number of days—	
	Average daily maximum	Average daily minimum	Monthly maximum will be equal to or higher than—	Monthly minimum will be equal to or lower than—	Average for the month	Maximum in the month	Minimum in the month	More than—	Less than—	Average snowfall	Snowfall is 1 inch or more—	Snow cover is 1 inch or more—
	° F.	° F.	° F.	° F.	Inches	Inches	Inches	Inches	Inches	Inches	Days	Days
January	24	4	43	−12	0.7	2.2	(1)	0.9	0.2	5.7	2	21
February	30	9	46	−10	.7	2.8	(1)	1.4	.5	8.4	2	18
March	42	22	62	4	1.4	3.4	0	1.9	1.0	13.0	3	18
April	59	34	78	21	2.4	6.0	0	2.9	1.3	2.4	1	2
May	71	45	86	33	3.4	9.4	0.1	4.4	1.9	(1)	0	0
June	80	56	92	44	4.3	8.4	.4	5.3	3.5	0	0	0
July	88	62	97	51	3.0	9.1	.3	3.3	2.3	0	0	0
August	85	60	95	48	3.3	9.3	.4	4.1	2.3	0	0	0
September	75	49	88	34	2.9	8.3	(1)	3.6	1.8	0	0	0
October	63	37	78	24	1.5	6.9	(1)	1.7	.4	.2	0	0
November	43	21	64	3	1.1	3.7	0	1.6	.5	4.9	2	6
December	29	9	46	−7	.7	3.0	(1)	.9	.3	6.1	2	18
Year [2]	58	34			25.4	36.1	10.4	27.7	22.8	40.7	12	83

[1] Trace.
[2] Average yearly maximum and minimum daily temperatures; yearly average, maximum, and minimum precipitation; probable total precipitation 3 years in 10; yearly average snowfall and total days in year with an inch or more of snowfall or snow cover.

At least one day is likely to have a temperature as low as −20° every winter. On most days between December 15 and February 14 the highest daytime temperature does not exceed 32°.

The last day in spring on which a temperature of 32° or colder occurs is about May 7; the first day in fall is about October 1. Thus the average length of the freeze-free season is about 147 days. However, the length of freeze-free seasons varies from 100 to 200 days. In 7 years out of 10, this season ranges from 130 to 160 days. In most seasons the last freeze in spring occurs between April 25 and May 15, and the first freeze in fall between September 20 and October 10. Table 9 lists probabilities and the dates of the last damaging cold temperature in spring and the first in fall.

TABLE 9.—*Probability of last damaging cold temperature in spring and first in fall*

[All data from Sioux Falls, South Dak.]

Damaging temperature	Probability [1]		
	1 year in 10	2 years in 10	5 years in 10
Spring:			
16° F. after	April 11	April 3	March 27.
20° F. after	April 28	April 13	April 2.
24° F. after	May 1	April 24	April 13.
28° F. after	May 14	May 7	April 24.
32° F. after	May 23	May 16	May 8.
36° F. after	May 31	May 27	May 14.
Fall:			
16° F. before	October 28	November 2	November 10.
20° F. before	October 18	October 22	November 2.
24° F. before	October 5	October 12	October 21.
28° F. before	September 21	September 27	October 9.
32° F. before	September 18	September 22	September 29.
36° F. before	September 11	September 16	September 25.

[1] Probability that there will be temperatures of 16° F. or lower, 20° F. or lower, 24° F. or lower, 28° F. or lower, 32° F. or lower, 36° F. or lower in spring after date indicated, or in fall before date indicated.

Precipitation

From April through September, precipitation normally totals 18 to 19 inches, or about 75 percent of the amount annually expected. In 3 years out of 10, the total from April to September equals or exceeds 21 inches, and in 1 or 2 out of 10 years, the total is 15 inches or less. Normally, in the period from May through August, the expected rainfall amounts to about 14 inches, the greater part of which is likely to fall in the first half of the period. If distribution is good, this amount is ample for crop production, but in nearly every growing season there is one period or more of deficient rainfall.

The amount of precipitation received from October through March appears to be important for the growth of crops the following summer, but in this period only about 6 inches, or 25 percent, of the annual precipitation falls in Minnehaha County. A shortage of precipitation in fall, in winter, and early in spring lowers reserve moisture in the soil and endangers successful crop production the following summer, unless precipitation during the growing season is above normal and is well distributed. Conversely, if precipitation is near or above normal from October through March, the reserve of soil moisture counteracts the effect of subnormal or poorly distributed rainfall in the following growing season.

During the growing season, precipitation usually comes in showers and thundershowers of short duration rather than from storms that produce steady but less intense rainfall for a period of several hours to more than a day. Precipitation of 1 inch or more in 24 hours occurs once or more during the growing season, and precipitation in excess of 2 inches occurs once or twice in approximately 6 out of 10 growing seasons.

Table 10 shows the percentage of chance, or the number of chances in 100, of receiving a trace, none, or a measured amount of precipitation in a 1-week period. By referring to table 10, it can be seen that for the week beginning June 7, the chances of weekly precipitation totaling a trace, or less, are 8 in 100. In that week the chances of receiving 1 inch of precipitation, or more, are 44 in 100.

The percentage of chance for given amounts of precipitation by a 2-week period is presented in table 11, and for a 3-week period in table 12. Tables 11 and 12 are used the same way as is table 10.

In Minnehaha County the chances of receiving 1 inch of precipitation in 1 week are less than 10 out of 100 during March. The chances increase rapidly in April, and from late in April through May the chances for 1 inch of precipitation per week are 26 to 36 in 100. The percentage of chance for 1 inch of rain reaches its highest point of the year in June, which has a probability varying between 31 and 46 percent. The chances decline during the early part of July and from then to late in September the probability varies between 20 and 30 percent. The percentage of chance of about 1 inch of precipitation in 1 week decreases sharply through the early part of October and then decreases at a slow, steady rate to a minimum of about 1 chance in 100 during most of January. A similar seasonal trend is evident in the percentage of chance in any week for other amounts of measurable precipitation listed in table 10.

The percentage of chance for 1 inch of precipitation in 2 weeks or 3 weeks shows the same seasonal trend. For example, there is a rapid increase in April, a yearly maximum in June, a secondary peak in August and September, a sharp decrease in October, and a yearly minimum during winter. (See tables 11 and 12.)

A high temperature accompanied by little or no precipitation for a week or more is important in the production of crops in Minnehaha County. Under these conditions soil moisture is exhausted rapidly in the upper layers, and small grains, corn, and other crops are injured or their yields are reduced, especially if the content of moisture in the subsoil is low.

During the growing season in Minnehaha County, an average of four periods of 7 days may be expected in which the average temperature is 85° or higher and precipitation is 0.10 inch or less. A survey of weather records for 10 years showed that the number of such 7-day periods varied from at least one every growing season to as many as six in 2 years out of 10. In many years two of these 7-day periods of hot, dry weather are consecutive; that is, they last for 14 days. Occasionally they last for 21 days.

Weekly periods of hot, dry weather (average maximum temperature 85° or higher and total precipitation 0.10 inch or less) occur most commonly in the last half of July, and in 6 years out of 10, one of these weeks may be expected. Early in July and for each week in August the frequency of a week of hot, dry weather decreases to about 4 out of 10 years.

TABLE 10.—*Chance, in percent, of receiving stated amounts of precipitation during a 1-week period at Sioux Falls, South Dakota (2)*

Week beginning	Probability of receiving at least—						
	Trace or none	0.20 in.	0.60 in.	0.80 in.	1.00 in.	1.60 in.	2.00 in.
January 3	44	20	2	1	(1)	0	0
January 10	50	27	6	3	1	0	0
January 17	37	18	2	1	(1)	0	0
January 24	32	32	10	6	4	(1)	0
January 31	33	37	13	8	5	1	(1)
February 7	37	31	8	4	2	(1)	0
February 14	39	34	13	8	5	1	(1)
February 21	33	35	8	4	2	0	0
March 1	32	44	17	10	6	1	(1)
March 8	37	35	13	8	5	1	(1)
March 15	32	41	18	12	8	3	1
March 22	32	44	19	13	9	3	1
March 29	33	44	13	7	4	(1)	0
April 5	20	56	30	22	16	6	3
April 12	37	49	28	21	16	7	4
April 19	11	66	43	36	29	17	12
April 26	15	70	44	34	26	12	7
May 3	11	71	44	34	27	13	8
May 10	11	68	44	35	28	15	10
May 17	9	73	46	36	29	14	9
May 24	19	70	51	43	36	22	15
May 31	8	78	52	42	34	18	12
June 7	8	85	63	53	44	24	16
June 14	8	77	52	42	35	19	13
June 21	6	85	64	55	46	28	20
June 28	9	74	48	39	31	16	10
July 5	17	72	49	40	32	17	11
July 12	20	66	40	31	23	10	6
July 19	20	63	38	29	23	11	6
July 26	19	61	40	33	27	15	11
August 2	9	72	45	36	29	15	9
August 9	11	69	46	38	31	18	12
August 16	13	68	39	29	22	9	5
August 23	20	61	39	32	26	14	9
August 30	22	54	30	23	17	8	5
September 6	17	69	46	37	30	16	10
September 13	24	63	43	35	29	16	11
September 20	26	57	35	28	22	11	7
September 27	33	46	25	19	14	6	4
October 4	24	49	28	21	17	8	5
October 11	39	40	19	13	9	3	2
October 18	45	33	16	11	8	3	2
October 25	46	37	17	11	8	2	1
November 1	43	37	17	2	8	3	1
November 8	35	41	20	14	10	4	2
November 15	54	31	15	11	8	3	1
November 22	41	31	12	7	5	1	(1)
November 29	39	33	11	7	4	1	(1)
December 6	46	24	6	3	2	0	0
December 13	45	23	4	2	1	0	0
December 20	50	25	9	5	3	1	(1)
December 27	48	27	9	5	3	1	(1)

[1] Chances less than 0.5, but greater than 0.

TABLE 11.—*Chance, in percent, of receiving stated amounts of precipitation during a 2-week period at Sioux Falls, South Dakota (2)*

Week beginning	Probability of receiving at least—						
	Trace or none	0.20 in.	0.60 in.	1.00 in.	1.40 in.	2.00 in.	2.80 in.
January 3	24	44	12	3	1	0	0
January 17	15	46	17	6	2	1	0
January 31	19	56	26	12	5	2	(1)
February 14	11	59	25	11	5	1	(1)
March 1	13	63	33	17	9	3	(1)
March 15	13	67	38	22	12	5	2
March 29	8	79	48	27	15	6	1
April 12	2	86	64	47	35	21	11
April 26	0	94	75	57	41	25	12
May 10	2	91	73	57	44	28	16
May 24	0	96	83	68	54	37	22
June 7	2	97	90	77	63	43	24
June 21	0	96	83	69	56	41	26
July 5	4	92	76	58	43	26	13
July 19	2	88	68	51	38	24	13
August 2	2	90	73	57	45	31	18
August 16	6	87	68	51	37	23	11
August 30	8	87	69	51	37	22	11
September 13	8	87	70	53	39	25	13
September 27	13	69	47	33	23	14	7
October 11	20	60	35	20	12	6	2
October 25	24	58	33	20	12	6	2
November 8	22	56	33	21	13	7	3
November 22	17	55	26	12	6	2	(1)
December 6	19	44	13	4	1	(1)	0
December 20	28	46	20	9	4	(1)	0

[1] Chance less than 0.5, but greater than 0.

TABLE 12.—*Chance, in percent, of receiving stated amounts of precipitation during a 3-week period at Sioux Falls, South Dakota (2)*

Week beginning	Probability of receiving at least—						
	Trace or none	0.20 in.	0.60 in.	1.00 in.	2.00 in.	2.80 in.	4.00 in.
January 10	11	59	28	13	2	(1)	0
January 31	6	71	40	22	5	1	(1)
March 1	8	76	49	31	9	4	1
March 22	2	91	66	43	13	5	(1)
April 12	2	97	87	74	41	24	10
May 3	0	98	89	77	48	30	14
May 24	0	100	98	93	69	48	24
June 14	0	99	95	87	63	45	26
July 5	2	95	84	71	43	27	13
July 26	0	97	87	75	48	33	17
August 16	2	96	84	69	37	21	8
September 6	4	95	89	78	48	29	12
September 27	6	82	61	45	21	11	4
October 18	8	74	47	30	10	4	1
November 8	9	71	45	29	10	4	1
November 29	11	65	30	13	6	1	0
December 20	17	61	28	12	1	(1)	0

[1] Chance less than 0.5, but greater than 0.

Storms

Blizzards occur in about one winter out of three. At about the same frequency, storms with freezing rain are observed. Occasionally in summer vigorous thunderstorms are accompanied by destructive hail, by high wind, or by both. On the average, one or two destructive hailstorms strike some part of the county during each growing season. Although tornadoes have occurred in the county, they are relatively infrequent.

Wind

The prevailing wind in the county is from the south from May through October and from the northwest the rest of the year. Average velocity ranges from 9 to 10 miles per hour during the summer and from 9 to about 13 miles per hour in spring. At its highest average velocity, wind in excess of 25 miles per hour may be expected about 10 percent of the time. In the summer the afternoon relative humidity averages close to 50 percent. The average number of clear days per year is about 105, and nearly half of them occur from July through October. The average number of cloudy days is about 150 per year. Partly cloudy days make up the rest.

Geology, Relief, and Drainage[8]

Minnehaha County lies at the extreme southern edge of the Coteau des Prairies (Prairie Hills) section of the Central Lowland Province in the western part of the United States (*9*).

The total relief is approximately 570 feet and ranges from about 1,820 feet in the northwestern corner of the county to about 1,250 feet on the southeastern border.

The Big Sioux River and its tributaries drain the county. In the eastern two-thirds of the county the drainage is dendritic, and stream dissection is generally well developed. In the western third of the county, natural drainage is poorly defined, for only a rudimentary drainage system has developed (*10, 11*).

Minnehaha County was invaded by the Nebraskan, the Kansan, the Illinoian, and the Wisconsin glaciers, which deposited drift of variable thickness on Precambrian quartzites and Cretaceous chalks and shales. Only the drift from Illinoian and Wisconsin glaciers is exposed in the county. The Wisconsin stage of the Pleistocene epoch was one of general deglaciation and subsequent reexpansion of the ice sheet. In Minnehaha County the Wisconsin stage is divided into three substages. From oldest to youngest these substages are the Iowan, the Tazewell, and the Cary.

Glacial action eroded, or ground up, the local bedrock and mixed it with material that was carried down from the north. When the glaciers melted, silt, clay, sand, and gravel were left as unconsolidated deposits.

After the Illinoian ice melted, a long period elapsed during which streams formed a well-developed drainage pattern and a mature topography (*10, 11*).

As the glaciers advanced in late Wisconsin time, the newly deposited drift obliterated features of the former landscape and the drainage system. As a result, the topographic features of the county became subdued and youthful. The Wisconsin ice did not advance east of Skunk Creek. This is shown by abrupt differences in topographic features between the area east and that west of Skunk Creek.

During the interglacial periods of the Wisconsin stage, the climate was extremely dry, and winds were rather strong. The strong winds picked up dry, fine sediments and deposited them in thick layers (*3*). These interglacial sediments, called loess, mantle a large part of the eastern two-thirds of the county.

Rock formations of the Cretaceous and the Precambrian geologic systems underlie the glacial sediments (fig. 15). The Cretaceous deposits include the Pierre and Niobrara formations. The Pierre formation consists of dark-gray, fissile shale that contains numerous beds of bentonite and concretions of iron and limestone (*12, 13*). This formation was a main source of sediment in the early glacial drift. Pierre shale underlies glacial deposits only in the extreme northwestern corner of the county. The Niobrara formation is composed of dark-gray to blue chalk and marl (*12, 13*). It underlies glacial sediments only in the extreme western part of the county.

The Sioux quartzite is of Precambrian age. It is a metamorphosed sedimentary sandstone that consists predominantly of pink-coated, fine grains of quartz sand cemented by silica. The Sioux quartzite underlies glacial sediments throughout most of the county. This quartzite forms a ridge that crosses the county from east to west. If it is present, Cretaceous sediment overlaps the ridge. Sioux quartzite crops out in several parts of the county.

Pleistocene glacial and interglacial deposits and recent alluvium make up the surficial deposits in Minnehaha County. Recent alluvium is on flood plains of the main streams. Its thickness varies considerably but averages about 10 feet. Alluvium is composed of clay, silt, sand, and gravel that have been reworked by present streams. In these areas of recent alluvium are the Luton, the Dimmick, and the Rauville soils.

Pleistocene glacial deposits cover about nine-tenths of the total surface of the county. These deposits range in thickness from a few feet to about 200 feet. The glacial materials were deposited as end or ground moraines, kames, outwash plains, or terraces.

Iowan kames consist of fairly well sorted, bedded sand and gravel that formed as knolls and are located in the vicinity of remnants of end moraines. In this area are the Sioux and the Fordville soils.

Cary outwash consists of poorly sorted or stratified sand and gravel. In the outwash areas are the Hecla, the Hamar, Fordville, and the Estelline soils.

Cary kame terrace consists of fine to coarse sand and gravel. Exposures are recorded to a depth of 60 feet. The Sioux is the main soil in this area.

Iowan and Illinoian ground moraines are spread over the eastern two-thirds of the county, but they are covered by a loess mantle that varies in thickness from a few feet to more than 40 feet (fig. 16). In this loess the Moody, the Nora, the Crofton, and the Trent soils developed. Where the loess mantle is thinner, the Kranzburg soils have developed. This area has a mature topography and a well-developed drainage system.

[8] This subsection was written by JOHN A. WILSON, geologist, Soil Conservation Service.

Iowan end moraine forms a broad, ridgelike area that extends from northwest of Sherman towards Dell Rapids. This area is mantled by thinner loess than that in the area where Moody soils occur; Kranzburg soils are in this area.

The Tazewell valley train outwash is a meltwater deposit of gravel, sand, and silt left in narrow stream valleys. The main soils on this outwash are the Flandreau and the Athelwold soils.

Cary end moraine occupies the western one-third of the county. The Cary till area has a youthful topography with numerous small, undrained depressions, the largest of which is Wall Lake (*10, 11*). A small percentage of gravelly outwash deposits is present in the form of moderately rolling hills. The main soils in this area are the Kranzburg, the Parnell, the Hidewood, and the Sinai.

A broad, clayey, high terrace consisting of old alluvium is west of Valley Springs. The main soil of this area is the Benclare.

History

In 1683 LeSeur, a French fur trader, explored along the Big Sioux River as far south as Sioux Falls. In 1700 his men traded furs in this general area. Dr. Joseph N. Nicollet traveled in this vicinity and wrote a description of the falls of the Big Sioux River. Dr. G. M. Staples,

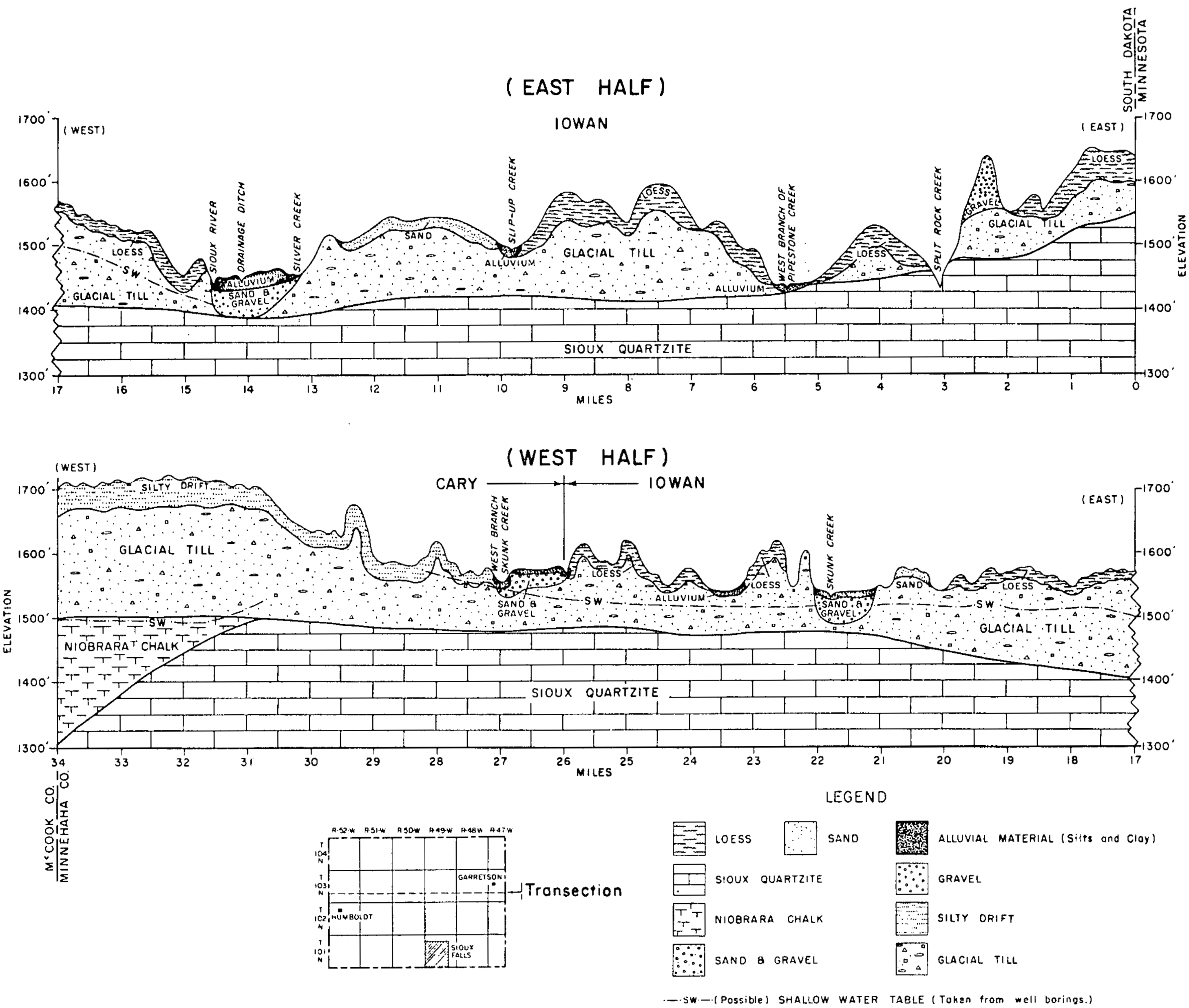

Figure 15.—**Geologic profile showing underlying rock formation. Niobrara chalk is Cretaceous; Sioux quartzite is Precambrian.**

after reading Dr. Nicollet's "Travels in the Northwest," which described the falls, organized the Western Town Company. In 1856 this company sent men to take possession of land at the present site of Sioux Falls, but the first settlement did not begin until 1857. In the same year the Dakota Land Company was organized in St. Paul, Minn., and it started a settlement south of the first settlement. In June 1857 the population of the county was 5 men, but by winter it had increased to 17.

In 1858 a sod fort was built for protection from Indians. Population increased to 35 men and 1 woman. The first newspaper appeared in the county on June 2, 1859.

Three constitutional conventions met in Sioux Falls, and the people of the county helped frame the Constitution for the area that became a State in 1889. At one time the area east of the Big Sioux River was included in the Minnesota Territory, but this was changed in 1858 when Minnesota was admitted as a State. Before the formal organization of Dakota Territory, activities of the provisional government were carried on in Sioux Falls.

Because of an Indian uprising in 1862, the U.S. Cavalry was ordered to take the settlers to Yankton. Most of the buildings were burned, and settlers did not return to the Big Sioux River valley until 1865, after a military post was established.

In 1868 Scandinavian families settled in the county near Baltic and Dell Rapids. The first county fair was held in 1874. In the same year grasshoppers destroyed the crops.

The first railroad entered the county at Valley Springs in June 1878, and the first passenger train reached Sioux Falls on August 1, 1878.

Industry and Transportation

Industry in the county provides outlets for a large quantity of the farm produce. A meat packing firm in Sioux Falls operates the largest single industrial plant.

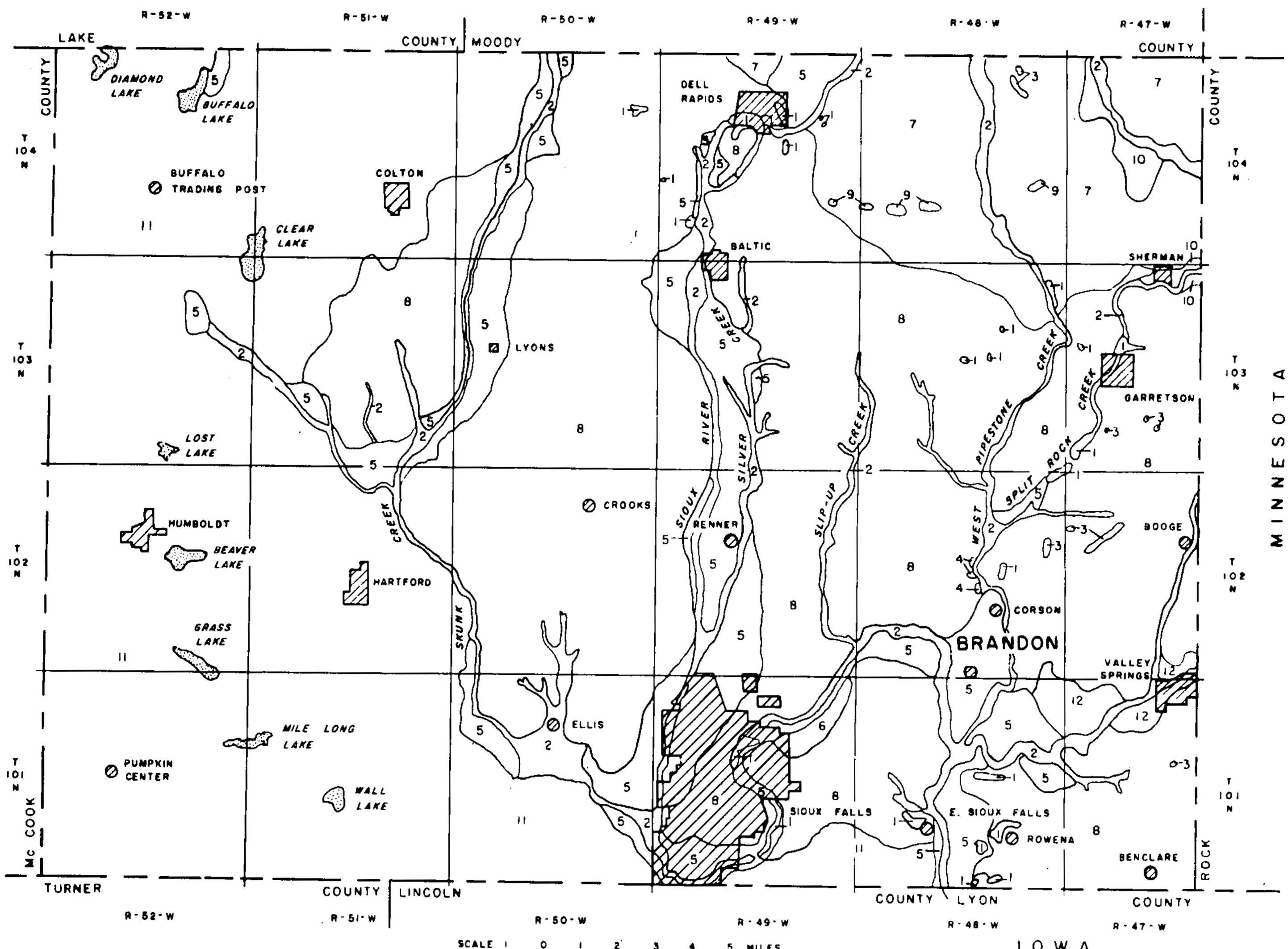

Figure 16.—**Generalized geologic map showing the distribution of sediments over the surface of the county: (1) Sioux formation; (2) alluvium; (3) Iowan kame; (4) Corson intrusive; (5) Cary outwash; (6) Cary kame terrace; (7) Iowan ground moraine; (8) Illinoian ground morain; (9) Iowan end moraine; (10) Tazewell Valley Train outwash; (11 Cary end moraine; (12) old alluvium (high terrace).**

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Sioux Falls is one of the 10 largest livestock markets in the United States. Other outlets for farm produce in Sioux Falls and smaller towns in the county are creameries, feed and seed mills, and bakeries.

Paved roads connect small towns and are joined by graveled roads from farms. Consequently, farmers have easy access to market.

Five railroads serve the county. Several intrastate and interstate truck lines assist in transporting farm produce. Three major airlines have flights daily from Sioux Falls to New York, San Francisco, Los Angeles, Chicago, and New Orleans.

Community Facilities and Recreation

Throughout Minnehaha County there are many rural grade schools, and in the small towns are grade schools and high schools. Sioux Falls has 32 public and parochial schools, two arts and sciences colleges, a business college, a hospital and school for crippled children, two training schools for nurses, a theological seminary, a school for the deaf, and many technical schools. Improvement in school facilities in Sioux Falls and in other towns has been outstanding in the past decade.

The county has more than 100 churches, 71 of which are in Sioux Falls. Nearly every religion is represented.

The two State parks in the county are the Palisades near Garretson, and the Dells near Dell Rapids. Nearly every town has a park, and there are 17 parks in Sioux Falls.

A large part of the business in Sioux Falls consists of wholesaling and distributing farm products, automotive equipment, machinery, petroleum, and electrical, pharmaceutical, and building supplies. Many retail stores are in or near the county. Many banks serve the area. Their annual clearings are more than 500 million dollars. The people are informed and entertained by many newspapers and television and radio stations.

Land Use

According to the 1959 Census of Agriculture, 94 percent of the land area was in farms. In that year there were 2,439 farms. The 1959 census reported 491,584 acres in farmland, of which 398,793 acres was cropland, 63,372 acres was in pasture that was not cropland or woodland, 3,342 acres was woodland, and 26,077 acres was other land.

Crops

A summary of the acreage harvested, the yield of principal crops in Minnehaha County in 1952, and the average yield for 20 years, 1931 through 1950, are given in table 13.

A summary of the acreage harvested and yield of crops grown for hay in 1952 and for 10 years, 1941 through 1950, is given in table 14. Not listed in table 14 are the acreage and yield of alfalfa seed and sweetclover seed. In the period between 1941 and 1950, the average acreage of alfalfa harvested for seed was 220 acres, and the average yield per acre was 47 pounds. In that period the average annual production was 10,700 pounds. The average acreage of sweetclover harvested for seed in 1951 was 70 acres, and the average yield was 110 pounds. The total production for 1951 was 7,700 pounds. In the period between 1941 and 1950, the average acreage of sweetclover harvested for seed was 310 acres, and the average yield was 111 pounds. In that period the average annual production was 35,500 pounds.

A summary of the acreage harvested, the average yield per acre, and the total yield of principal crops for 6 years, 1956 through 1961, is given in table 15.

TABLE 13.—*Acreage harvested and yield of principal crops in 1952 and for period 1931–50* [1]

Crop	Area harvested		Yield		Production	
	1952	Average (1931–50)	1952	Average (1931–50)	1952	Average (1931–50)
	Acres	*Acres*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Corn, all	160, 900	161, 400	41. 0	30. 2	6, 596, 900	4, 890, 800
Wheat:						
Durum	200	600	9. 0	13. 4	1, 800	8, 400
Winter	40	130	18. 0	13. 0	720	1, 960
Other spring	400	2, 000	9. 5	13. 4	3, 800	27, 800
All	640	2, 700	9. 9	13. 4	6, 320	38, 200
Oats	151, 300	111, 000	37. 0	31. 0	5, 598, 100	3, 607, 900
Barley	1, 300	26, 400	25. 0	23. 0	32, 500	659, 700
Rye (for grain)	200	2, 400	14. 0	14. 6	2, 800	37, 200
Flaxseed	3, 600	6, 900	13. 5	9. 0	48, 600	74, 000
Potatoes	200	1, 100	240. 0	73. 0	48, 000	71, 500

[1] Data in this table are from estimates made annually for all counties and published in the annual reports of the South Dakota Crop and Livestock Reporting Service, a cooperative service of the USDA and the S. Dak. Dept. of Agr. (*15*).

TABLE 14.—*Acreage and yield of crops grown for hay in 1952 and for period 1941–50* [1]

Crop	Area harvested		Yield per acre		Production	
	1952	Average (1941–50)	1952	Average (1941–50)	1952	Average (1941–50)
	Acres	*Acres*	*Tons*	*Tons*	*Tons*	*Tons*
Alfalfa hay	30, 500	21, 100	2. 20	1. 70	67, 100	36, 700
All other tame hay	6, 090	9, 300	1. 65	1. 29	10, 000	10, 400
All tame hay	36, 590	30, 400	2. 11	1. 60	77, 100	47, 000
Wild hay	11, 000	13, 600	1. 25	. 98	13, 800	13, 000
All hay	47, 590	44, 000	1. 91	1. 36	90, 900	60, 000

[1] Data in this table are from estimates made annually for all counties and published in the annual reports of the South Dakota Crop and Livestock Reporting Service, a cooperative service of the USDA and the S. Dak. Dept. of Agr. (*15*).

TABLE 15.—*Acreages harvested and yield of principal crops in 1956 through 1961* [1]

Crop	Year	Area harvested	Average yield	Total yield
		Acres	*Bu. per acre*	*Bu.*
Corn.	1956	164, 700	43. 5	7, 164, 400
	1957	174, 900	48. 5	8, 482, 600
	1958	180, 800	34. 5	6, 237, 600
	1959	203, 300	38. 0	7, 725, 400
	1960	182, 200	49. 5	9, 018, 900
	1961	145, 800	46. 5	6, 779, 700
Oats.	1956	110, 100	22. 5	2, 477, 200
	1957	104, 200	34. 0	3, 542, 800
	1958	95, 400	39. 0	3, 720, 600
	1959	88, 900	33. 5	2, 978, 200
	1960	90, 500	47. 5	4, 398, 800
	1961	88, 400	42. 0	3, 712, 800
All wheat.	1956	120	9. 8	1, 170
	1957	290	21. 5	6, 240
	1958	230	25. 1	5, 770
	1959	800	21. 0	16, 800
	1960	500	19. 8	9, 920
	1961	680	18. 0	12, 230
Barley.	1956	1, 600	17. 5	28, 000
	1957	2, 800	35. 5	99, 400
	1958	2, 800	33. 0	92, 400
	1959	5, 300	28. 0	148, 400
	1960	4, 700	38. 5	181, 000
Flax.	1956	6, 200	8. 0	49, 600
	1957	2, 500	8. 0	20, 000
	1958	2, 800	11. 0	30, 800
	1959	1, 600	10. 5	16, 800
	1960	1, 500	14. 0	21, 000
	1961	1, 500	14. 5	21, 800
Soybeans.	1956	10, 700	14. 5	155, 200
	1957	7, 800	22. 0	171, 600
	1958	12, 400	12. 5	155, 000
	1959	7, 500	19. 0	142, 500
	1960	5, 500	22. 0	121, 000
	1961	8, 900	21. 0	186, 900
Sorghum.[2]	1958	2, 300	31. 0	71, 300
	1959	800	43. 5	34, 800
	1960	1, 100	52. 0	57, 200
	1961	700	42. 0	29, 400
All hay.	1956	59, 100	1. 82	107, 700
	1957	59, 100	2. 43	143, 500
	1958	49, 800	1. 71	85, 400
	1959	53, 800	1. 95	105, 160
	1960	49, 600	2. 46	121, 900
	1961	47, 500	2. 37	112, 470
Alfalfa hay.	1956	42, 500	2. 15	91, 400
	1957	48, 000	2. 70	129, 600
	1958	42, 700	1. 85	77, 100
	1959	42, 600	2. 15	91, 600
	1960	40, 100	2. 65	106, 300
	1961	39, 000	2. 60	101, 400
Wild hay.	1956	9, 900	1. 00	9, 900
	1957	7, 300	1. 20	8, 800
	1958	5, 700	1. 00	5, 700
	1959	7, 600	1. 15	8, 700
	1960	7, 800	1. 60	12, 500
	1961	7, 600	1. 25	9. 500

[1] Data in this table are from published reports of the South Dakota Crop and Livestock Reporting Service.
[2] Data not available for 1956 and 1957.

Number, Size, and Tenancy of Farms

In 1900 there were 1,908 farms reported. According to the census of agriculture, the number of farms increased to 2,551 in 1925, but since then it has decreased slightly. Table 16 lists the number, acreage, average size, and tenancy of farms for intervals of 10 years between 1890 and 1920, and for intervals of 5 years between 1920 and 1959.

The trend is toward fewer farms and a larger acreage per farm. Farm tenancy decreased from 55.6 percent in 1940 to 40.6 percent in 1959. Tenancy is more than the State average, which was 30.4 percent in 1950.

TABLE 16.—*Number, total acreage, average size, and tenancy of farms, 1890 to 1959*

Year	Total farms	Land in farms	Average size	Tenancy
		Acres	*Acres*	*Percent*
1890	1, 623	354, 551	218. 5	20. 8
1900	1, 908	491, 419	257. 6	33. 3
1910	2, 077	495, 610	238. 6	40. 0
1920	2, 294	488, 764	213. 1	45. 3
1925	2, 551	490, 395	192. 2	49. 7
1930	2, 423	500, 715	206. 7	54. 0
1935	2, 498	497, 109	199. 0	54. 2
1940	2, 458	500, 158	203. 5	55. 6
1945	2, 426	505, 013	208. 2	47. 1
1950	2, 439	502, 221	205. 9	42. 6
1954	2, 320	502, 115	216. 4	43. 4
1959	2, 041	491, 584	240. 9	40. 6

Population

In 1870 the population of Minnehaha County was 355, but a large influx of settlers raised the number to 8,251 by 1880. In 1890 the number was 21,879. Table 17 gives the population of Minnehaha County from 1900 to 1960, as reported by the United States Bureau of Census and the South Dakota Census.

TABLE 17.—*Population Minnehaha County, South Dakota, from 1900 to 1960*

[Figures for even-numbered years are from the U.S. Bureau of Census; those for odd-numbered years are from the South Dakota Census [1]]

Year	Total	Sioux Falls	Rural
1900	23, 926	10, 266	13, 660
1905	27, 282	----------	----------
1910	29, 631	14, 094	15, 537
1915	37, 613	----------	----------
1920	42, 490	25, 202	17, 288
1925	47, 493	----------	----------
1930	50, 872	33, 362	17, 510
1935	51, 297	----------	----------
1940	57, 697	40, 832	16, 865
1945	57, 932	----------	----------
1950	70, 910	52, 696	18, 214
1960	86, 575	65, 466	----------

[1] Only the total population is given in the South Dakota Census.

The 1960 United States Census shows Sioux Falls as the most populous city in the State. Table 18 gives the population in 1950 and 1960 for Sioux Falls and for some of the towns in the county. Data were not available for other towns in the county. Since 1950 South Sioux Falls has been a part of Sioux Falls.

TABLE 18.—*Population of cities and towns in Minnehaha County*

City or town	1950	1960
Sioux Falls	52, 696	65, 466
South Sioux Falls	1, 586	----------
Baltic	255	278
Colton	521	593
Dell Rapids	1, 650	1, 863
Garretson	745	850
Hartford	592	688
Humboldt	450	446
Sherman	120	116
Valley Springs	389	472

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Glossary

Acid. See Reaction.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is reduced.

Alluvium. Fine material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Azonal soils. A general group of soils having little or no soil profile development. Most soils of this category are young. In the United States, the azonal soils are members of the Alluvial, Lithosol, and Regosol great soil groups.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (soils engineering). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California, and abbreviated CBR. A soil with a CBR of 16 will support 16 percent of the load that would be supported by the standard crushed limestone, per unit area and with the same degree of distortion.

Carbonate. A compound formed when calcium, magnesium, or another element combines with carbon and oxygen. A layer of free carbonates is one of the distinguishing characteristics of a Chernozem.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, the soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose. Noncoherent; soil will not hold together in a mass.

Friable. When moist, soil crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic. When wet, soil readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, soil adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard. When dry, soil is moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft. When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented. Soil is hard and brittle; little affected by moistening.

Drainage, surface. Runoff, or surface flow, of water from an area.

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another;

includes drift materials deposited by glaciers and by streams and lakes associated with them.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Esker (geology). A narrow, winding ridge or mound of stratified gravelly and sandy drift that was deposited by a subglacial stream.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition (or tilth) of the soil, are favorable.

Friability. Term for the ease with which the soil crumbles. A friable soil is one that crumbles easily.

Genesis, soil. The manner in which the soil originated, with special reference to the processes responsible for the development of the solum, or the true soil, from the unconsolidated parent material.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Granule. A single mass, or cluster, of many individual soil particles.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Gravel. Rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter. An individual piece is a pebble.

Habitat. The natural abode of a plant or animal; it refers to the kind of environment in which a plant or animal normally lives, as opposed to its range, or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. The relative position of the several soil horizons in a typical profile, and their nomenclature, are as follows:

- A0 Organic debris, partly decomposed or matted.
- A1 A dark-colored horizon having a fairly high content of organic matter mixed with mineral matter.
- A2 A light-colored horizon, often representing the zone of maximum leaching where podzolized; absent in wet, dark-colored soils.
- A3 Transitional to B horizon but more like A than B; sometimes absent.
- B1 Transitional to B horizon but more like B than A; sometimes absent.
- B2 A usually darker colored horizon, which often represents the zone of maximum illuviation where podzolized.
- B3 Transitional to C horizon.
- C Slightly weathered parent material; absent in some soils.
- D Underlying substratum.

The A horizons make up a zone of eluviation, or leached zone. The B horizons make up a zone of illuviation, in which clay and other materials have accumulated. The A and B horizons, taken together, are called the solum, or true soil.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Interglacial. Occurring between two glacial periods or epochs.

Intrazonal soils. Any one of the great groups of soils having more or less well-developed soil characteristics that reflect a dominating influence of some local factor of relief or parent material over the normal influences of climate and vegetation.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Leached soil. A soil from which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

Liquid limit (soil engineering). The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Loam soil. Soil having approximately equal amounts of sand, silt, and clay.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Mapping unit. Any soil, miscellaneous land type, soil complex, or undifferentiated soil group shown on a detailed soil map and identified by a letter symbol.

Maximum density (soil engineering). The maximum weight per unit volume of soil when compacted with a standard or predetermined compactive effort at optimum moisture content.

Modal profile, soil. A profile typical of a soil series.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal (end), lateral, medial, ground.

Morphology, soil. The makeup of the soil, including texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons that make up the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many;* size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, value of 6, and chroma of 4. For absolute achromatic colors (pure grays, white, and black), which have zero chroma and no hue, the letter N (neutral) takes the place of a hue designation.

Optimum moisture (soil engineering). The moisture content of soil at which a given compactive effort will produce a soil mass that has maximum density.

Outwash. Crossbedded gravel, sand, and silt deposited by melt water as it flowed from the ice.

Oxidation. A chemical change of an element or compound combining with oxygen, or with more oxygen. A chemical change that results in a loss of oxygen is called reduction.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of the soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Plastic (soil consistence). Capable of being deformed without being broken.

Plastic limit (soil engineering). The moisture content at which a soil changes from a solid to a plastic state.

Plasticity index (soil engineering). The numerical difference between the liquid limit and the plastic limit; the range in moisture content within which the soil remains plastic.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Reduction. See Oxidation.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residue, crop. That part of plants left in the field after the crop is harvested.

Runoff. The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

Sheer strength (soil engineering). The maximum ability of soil to resist shearing or sliding along internal surfaces within a mass.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate, and living matter acting upon parent material, as conditioned by relief over periods of time.

Soil conservation. A process of protecting soil by mechanical structures or by management practices, or both, from loss or damage while it is being used to produce crops.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C and D horizons.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

Terrace (mechanical). An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called *second bottoms*, as contrasted to *flood plains*, and seldom are subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportions of fine particles, are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Translocation. The transfer of materials from one place or position to another, as when fine clay in the A horizon of a soil is moved into the B horizon below.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Unconsolidated (soil material). Soil material in a form of a loose aggregation.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Valley train. Graded gravel, sand, silt, or other material that has been deposited on valley floors by streams emerging from glaciers.

Water-holding capacity. The capacity (or ability) of soil to hold water. The water-holding capacity of sandy soils is usually low, and that of clay soils is high. This property is often expressed in inches of water per inch depth of soil.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places the water table fluctuates; that is, it is higher at one time than at another.

Zonal soils. Soils having well-developed characteristics that reflect the influence of the active factors of soil formation. The active factors are climate and living organisms, chiefly vegetation.

GUIDE TO MAPPING UNITS

[See table 2, p. 37, for estimated crop yields; see pp. 40 and 41, for woodland species and performance; see pp. 42 to 62, for information significant to engineering; see table 1, p. 6, for approximate acreage and proportionate extent of each soil]

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Windbreak suitability group Number	Windbreak suitability group Page
AcA	Alcester silt loam, 1 to 3 percent slopes	7	I-2	31	2	40
AcB	Alcester silt loam, 3 to 5 percent slopes	7	IIe-2	32	2	40
An	Alluvial land	7	Vw-1	35	5	41
Ar	Alluvial land, rocky	8	VIIs-81	36	(1)	
At	Athelwold silt loam	8	IIs-25	33	2	40
Bc	Benclare silty clay loam	9	IIs-1	32	3	41
Bd	Benclare silty clay loam, poorly drained	9	IVw-1	35	5	41
Be	Brookings silt loam	10	I-2	31	2	40
BKC2	Buse-Kranzburg loams, 5 to 9 percent slopes, eroded	10	IVe-22	35	2	40
BKD2	Buse-Kranzburg loams, 9 to 17 percent slopes, eroded	11	IVe-22	35	2	40
BKs	Buse-Kranzburg stony loams	11	VIIs-81	36	4	41
BmD	Buse loam, 9 to 17 percent slopes	11	VIe-22	36	4	41
BnE	Buse soils, steep	11	VIIe-22	36	(1)	
BoD	Buse stony loam, 5 to 17 percent slopes	11	VIIs-81	36	(1)	
BS	Buse-Sioux complex	11	VIIs-87	36	(1)	
BVC2	Buse-Vienna loams, 5 to 9 percent slopes, eroded	12	IVe-22	35	2	40
CoA	Corson silty clay, 1 to 3 percent slopes	12	IIs-1	32	3	41
CoB2	Corson silty clay, 3 to 5 percent slopes, eroded	12	IIIe-1	33	3	41
CoC2	Corson silty clay, 5 to 9 percent slopes, eroded	12	IIIe-1	33	3	41
CrC2	Crofton silt loam, 5 to 9 percent slopes, eroded	13	IVe-22	35	2	40
CrD2	Crofton silt loam, 9 to 17 percent slopes, eroded	13	IVe-22	35	2	40
CrE	Crofton silt loam, 17 to 30 percent slopes	13	VIe-22	36	2	40
Dm	Dimmick clay	14	Vw-11	35	(1)	
EgA	Egeland loam, 1 to 3 percent slopes	14	IIIs-3	34	2	40
EgB	Egeland loam, 3 to 5 percent slopes	14	IIIe-3	33	2	40
EgC2	Egeland loam, 5 to 9 percent slopes, eroded	14	IIIe-3	33	2	40
EsA	Estelline silt loam, 0 to 2 percent slopes	15	IIs-25	33	2	40
EsB	Estelline silt loam, 3 to 4 percent slopes	15	IIe-25	32	2	40
FaA	Flandreau loam, 1 to 3 percent slopes	15	IIs-25	33	2	40
FaB	Flandreau loam, 3 to 5 percent slopes	15	IIe-25	32	2	40
FaB2	Flandreau loam, 3 to 5 percent slopes, eroded	15	IIIe-2	33	2	40
FaC2	Flandreau loam, 5 to 9 percent slopes, eroded	16	IIIe-2	33	2	40
HH	Hecla-Hamar complex	17	IIIs-3	34	1	40
Hw	Hidewood silty clay loam	17	IVw-1	35	5	41
Hy	Hidewood silty clay loam, calcareous	18	IVw-1	35	5	41
KBA	Kranzburg-Beadle silty clay loams, 1 to 3 percent slopes	18	I-2	31	2	40
KBB	Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes	19	IIe-2	32	2	40
KBC	Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes	19	IIIe-2	33	2	40
KBuB	Kranzburg-Buse loams, 3 to 5 percent slopes	19	IIIe-23	34	2	40
KrA	Kranzburg silty clay loam, 1 to 3 percent slopes	19	I-2	31	2	40
KrB	Kranzburg silty clay loam, 3 to 5 percent slopes	19	IIe-2	32	2	40
KrC2	Kranzburg silty clay loam, 5 to 9 percent slopes, eroded	19	IIIe-2	33	2	40
La	Lamoure silty clay loam	20	IVw-11	35	2	40
Lp	La Prairie complex	20	I-2	31	2	40
Ls	La Prairie silt loam	21	I-2	31	2	40
Lu	Luton clay	21	IIIw-11	34	2	40
MdB2	Maddock loamy fine sand, 3 to 5 percent slopes, eroded	21	IVe-4	35	4	41
MdC2	Maddock loamy fine sand, 5 to 9 percent slopes, eroded	22	VIe-4	35	4	41
MdD2	Maddock loamy fine sand, 9 to 17 percent slopes, eroded	22	VIe-4	35	4	41
MNB	Moody-Nora silty clay loams, 3 to 5 percent slopes	23	IIe-2	32	2	40
MNB2	Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded	23	IIIe-2	33	2	40
MNC2	Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded	23	IIIe-2	33	2	40
MoA	Moody silty clay loam, 1 to 3 percent slopes	23	I-2	31	2	40
MoB	Moody silty clay loam, 3 to 5 percent slopes	23	IIe-2	32	2	40
MsA	Moody silty clay loam, moderately shallow, 0 to 2 percent slopes	23	IIIs-5	34	2	40
NCC2	Nora-Crofton silt loams, 5 to 9 percent slopes, eroded	24	IIIe-23	34	2	40
NCD2	Nora-Crofton silt loams, 9 to 17 percent slopes, eroded	24	IVe-22	35	2	40
Pa	Parnell silty clay loam	24	Vw-1	35	(1)	
Ra	Rauville silty clay loam	25	Vw-11	35	(1)	
Ro	Rock land	25	VIIIs-1	36	(1)	

See footnotes at end of table.

GUIDE TO MAPPING UNITS—Continued

Map symbol	Mapping unit	Page	Capability unit: Symbol	Capability unit: Page	Windbreak suitability group: Number	Windbreak suitability group: Page
SnA	Sinai silty clay, 1 to 3 percent slopes	25	IIs–1	32	2	40
SnB	Sinai silty clay, 3 to 5 percent slopes	26	IIIe–1	33	2	40
Te	Terrace escarpments	26	VIIs–6	36	(1)	
Tr	Trent silty clay loam	28	I–2	31	2	40
Ts	Trent-slickspot complex	28	IIs–1	32	5	41
VnA	Vienna silt loam, 1 to 3 percent slopes	28	I–2	31	2	40
VnB	Vienna silt loam, 3 to 5 percent slopes	28	IIe–2	32	2	40
VnC	Vienna silt loam, 5 to 9 percent slopes	28	IIIe–2	33	2	40
VnC2	Vienna silt loam, 5 to 9 percent slopes, eroded	29	IVe–22	35	2	40
WeA	Fordville loam, 1 to 3 percent slopes	16	IIIs–5	34	2	40
WeB	Fordville loam, 3 to 5 percent slopes	16	IIIe–5	34	2	40

[1] Soils are not suited for windbreaks.

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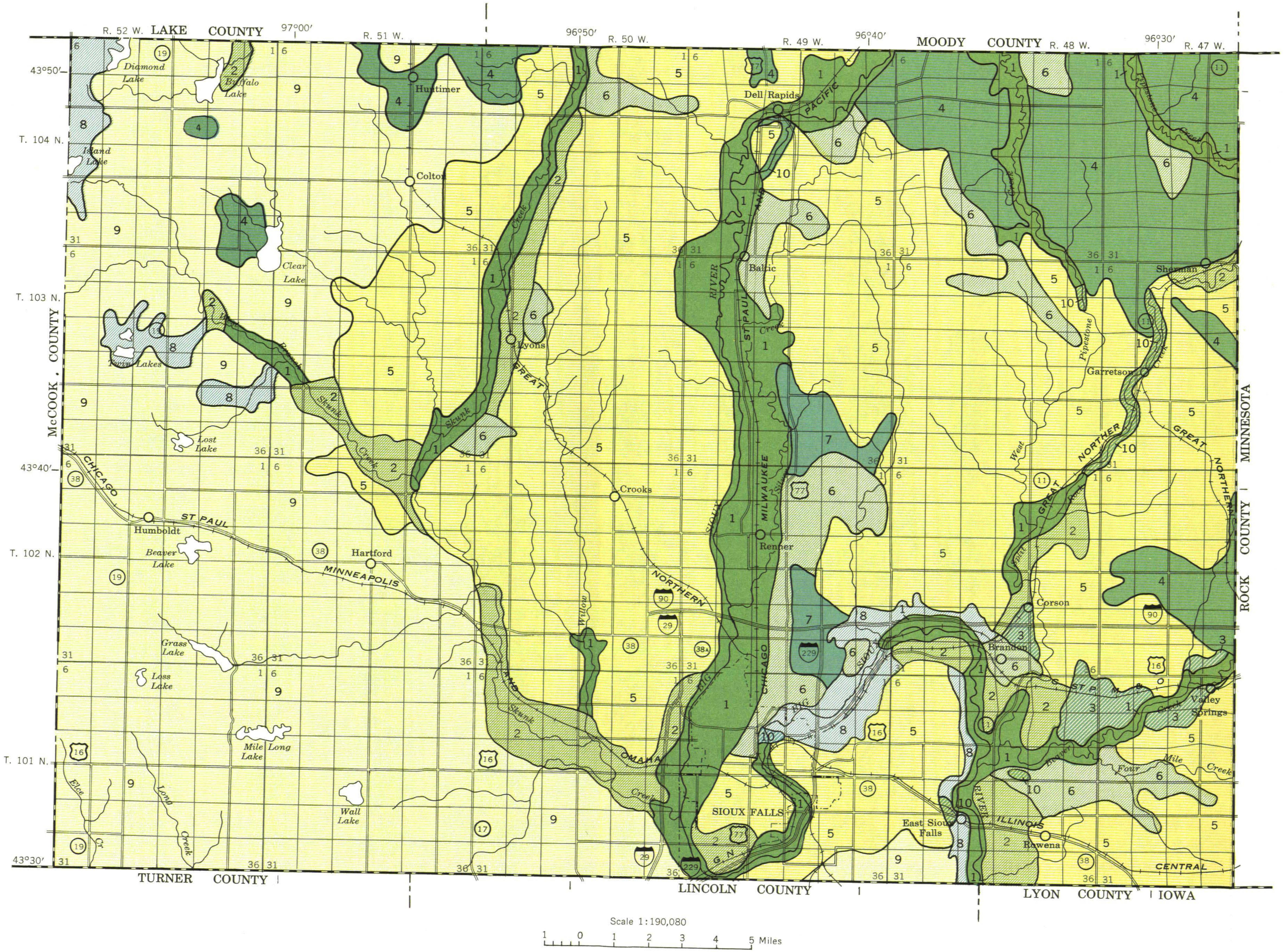


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

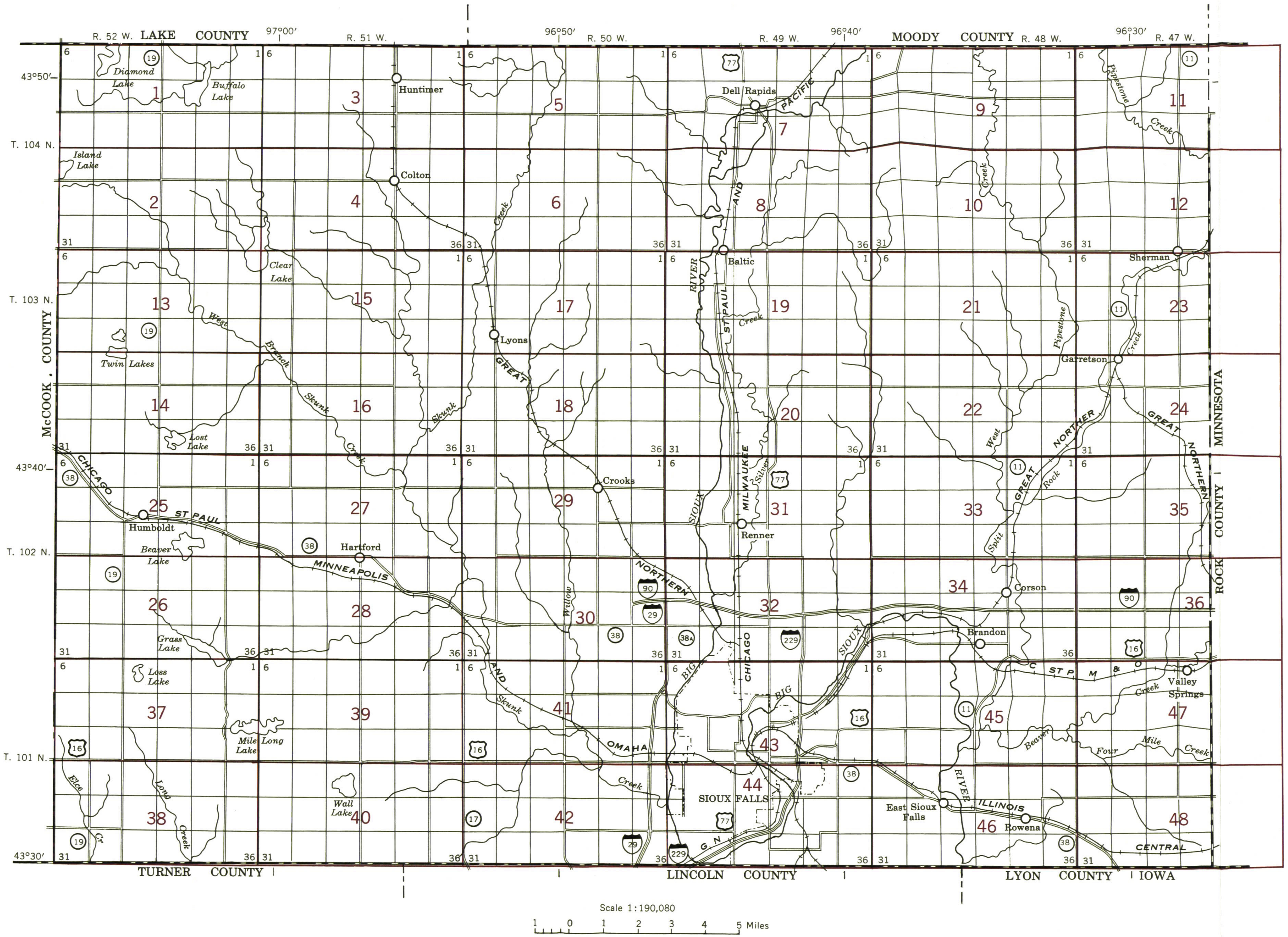
GENERAL SOIL MAP
MINNEHAHA COUNTY, SOUTH DAKOTA

SOIL ASSOCIATIONS

1. Luton-Dimmick association: Fine textured to moderately fine textured soils on flood plains
2. Fordville-Estelline association: Medium-textured soils over sand and gravel on stream terraces
3. Benclare association: Fine-textured soils in loess on stream terraces
4. Moody-Trent association: Moderately fine textured soils in loess on uplands
5. Nora-Moody association: Medium-textured and moderately fine textured soils in loess on uplands
6. Egeland-Maddock association: Medium-textured and coarse-textured soils in windblown sands on uplands and terraces
7. Vienna association: Medium-textured soils in glacial till on uplands
8. Buse-Sioux association: Coarse-textured and medium-textured soils in glacial drift
9. Kranzburg-Parnell association: Moderately fine textured and fine textured soils in loess and till
10. Rockland association: Rock outcrops and shallow soils

May 1963

INDEX
MINNEHAHA



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

MINNEHAHA COUNTY, SOUTH DAKOTA

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

SOIL LEGEND

Each mapping unit is identified by a symbol consisting of letters (AcA) or of letters and a number (BKD2). The first letter in the symbol, always a capital, is the first letter in the name of the mapping unit. The second letter is a capital if the mapping unit contains more than one kind of soil (BS), but it is small if the mapping unit is one kind of soil (Dm) or is a land type (Ro). A third letter, A, B, C, D, or E, indicates steepness of slope. If there is no letter for slope, the mapping unit is nearly level or has considerable range in slope. The number "2", at the end of a symbol indicates that the soil is eroded.

SYMBOL	NAME
AcA	Alcester silt loam, 1 to 3 percent slopes
AcB	Alcester silt loam, 3 to 5 percent slopes
An	Alluvial land
Ar	Alluvial land, rocky
At	Athelwold silt loam
Bc	Benclare silty clay loam
Bd	Benclare silty clay loam, poorly drained
Be	Brookings silt loam
BKC2	Buse-Kranzburg loams, 5 to 9 percent slopes, eroded
BKD2	Buse-Kranzburg loams, 9 to 17 percent slopes, eroded
BKs	Buse-Kranzburg stony loams
BmD	Buse loam, 9 to 17 percent slopes
BnE	Buse soils, steep
BoD	Buse stony loam, 5 to 17 percent slopes
BS	Buse-Sioux complex
BVC2	Buse-Vienna loams, 5 to 9 percent slopes, eroded
CoA	Corson silty clay, 1 to 3 percent slopes
CoB2	Corson silty clay, 3 to 5 percent slopes, eroded
CoC2	Corson silty clay, 5 to 9 percent slopes, eroded
CrC2	Crofton silt loam, 5 to 9 percent slopes, eroded
CrD2	Crofton silt loam, 9 to 17 percent slopes, eroded
CrE	Crofton silt loam, 17 to 30 percent slopes
Dm	Dimmick clay
EgA	Egeland loam, 1 to 3 percent slopes
EgB	Egeland loam, 3 to 5 percent slopes
EgC2	Egeland loam, 5 to 9 percent slopes, eroded
EsA	Estelline silt loam, 0 to 2 percent slopes
EsB	Estelline silt loam, 3 to 4 percent slopes
FaA	Flandreau loam, 1 to 3 percent slopes
FaB	Flandreau loam, 3 to 5 percent slopes
FaB2	Flandreau loam, 3 to 5 percent slopes, eroded
FaC2	Flandreau loam, 5 to 9 percent slopes, eroded
HH	Hecla-Hamar complex
Hw	Hidewood silty clay loam
Hy	Hidewood silty clay loam, calcareous
KBA	Kranzburg-Beadle silty clay loams, 1 to 3 percent slopes

SYMBOL	NAME
KBB	Kranzburg-Beadle silty clay loams, 3 to 5 percent slopes
KBC	Kranzburg-Beadle silty clay loams, 5 to 9 percent slopes
KBuB	Kranzburg-Buse loams, 3 to 5 percent slopes
KrA	Kranzburg silty clay loam, 1 to 3 percent slopes
KrB	Kranzburg silty clay loam, 3 to 5 percent slopes
KrC2	Kranzburg silty clay loam, 5 to 9 percent slopes, eroded
La	Lamoure silty clay loam
Lp	LaPrairie complex
Ls	LaPrairie silt loam
Lu	Luton clay
MdB2	Maddock loamy fine sand, 3 to 5 percent slopes, eroded
MdC2	Maddock loamy fine sand, 5 to 9 percent slopes, eroded
MdD2	Maddock loamy fine sand, 9 to 17 percent slopes, eroded
MNB	Moody-Nora silty clay loams, 3 to 5 percent slopes
MNB2	Moody-Nora silty clay loams, 3 to 5 percent slopes, eroded
MNC2	Moody-Nora silty clay loams, 5 to 9 percent slopes, eroded
MoA	Moody silty clay loam, 1 to 3 percent slopes
MoB	Moody silty clay loam, 3 to 5 percent slopes
MsA	Moody silty clay loam, moderately shallow, 0 to 2 percent slopes
NCC2	Nora-Crofton silt loams, 5 to 9 percent slopes, eroded
NCD2	Nora-Crofton silt loams, 9 to 17 percent slopes, eroded
Pa	Parnell silty clay loam
Ra	Rauville silty clay loam
Ro	Rock land
SnA	Sinai silty clay, 1 to 3 percent slopes
SnB	Sinai silty clay, 3 to 5 percent slopes
Te	Terrace escarpments
Tr	Trent silty clay loam
Ts	Trent-slickspot complex
VnA	Vienna silt loam, 1 to 3 percent slopes
VnB	Vienna silt loam, 3 to 5 percent slopes
VnC	Vienna silt loam, 5 to 9 percent slopes
VnC2	Vienna silt loam, 5 to 9 percent slopes, eroded
WeA	Fordville loam, 1 to 3 percent slopes
WeB	Fordville loam, 3 to 5 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Interchange

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries
- Mine dump
- Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.
- Crossable with tillage implements
- Not crossable with tillage implements

Canals and ditches — CANAL / DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions — Large / Small

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

Soil map constructed 1963 by Cartographic Division, Soil Conservation Service, USDA, from 1958 aerial photographs. Controlled mosaic based on South Dakota plane coordinate system, north zone, Lambert conformal conic projection. 1927 North American datum.

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

10

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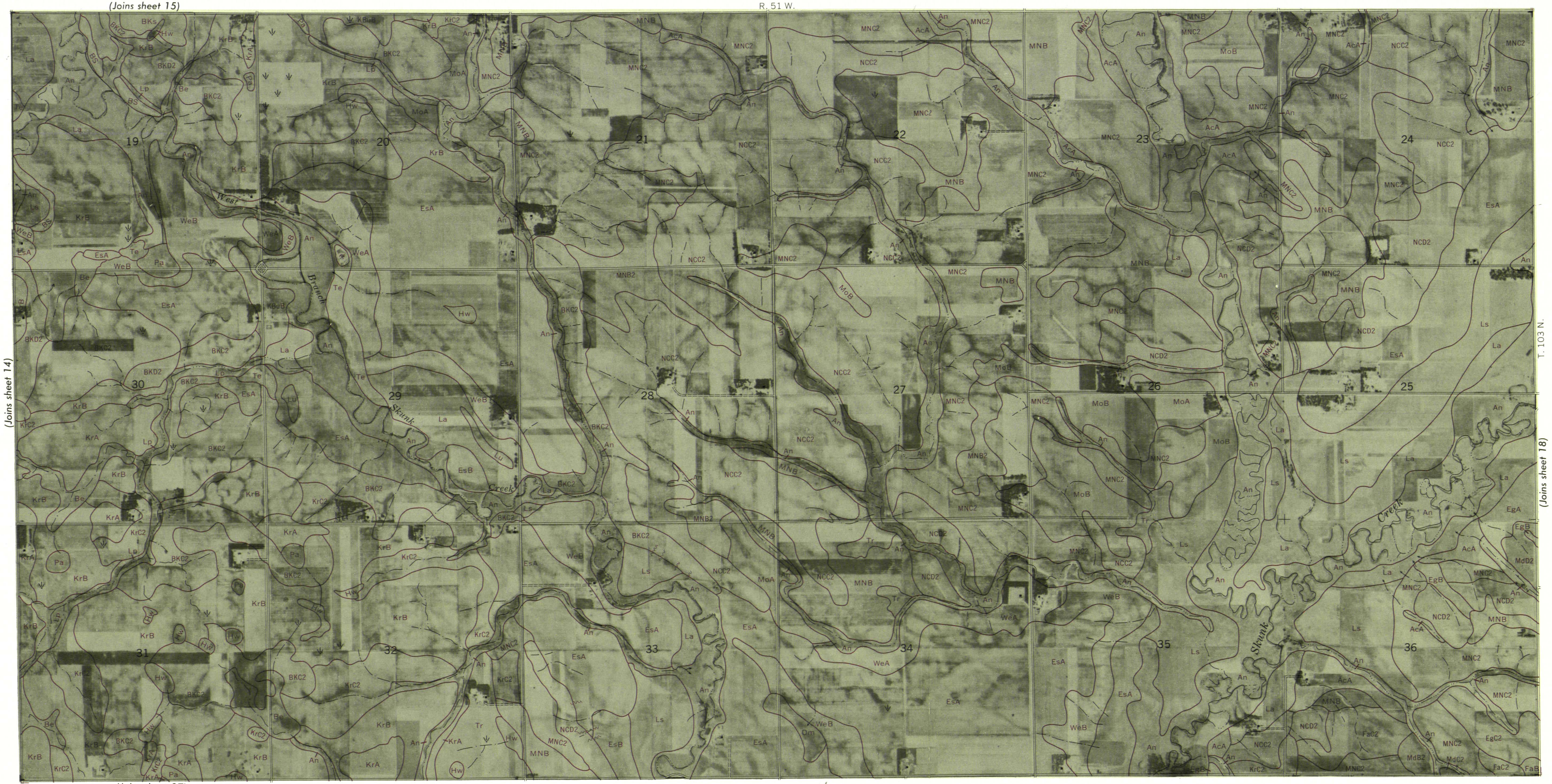
16

(Joins sheet 15)

R. 51 W.



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MINNEHAHA COUNTY, SOUTH DAKOTA — SHEET NUMBER 17

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0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

18

(Joins sheet 17)

R. 50 W.

(Joins sheet 29)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

R. 49 W.

(Joins sheet 8)

19

N

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T. 103 N.

(Joins sheet 17)

(Joins sheet 21)

(Joins sheet 20)

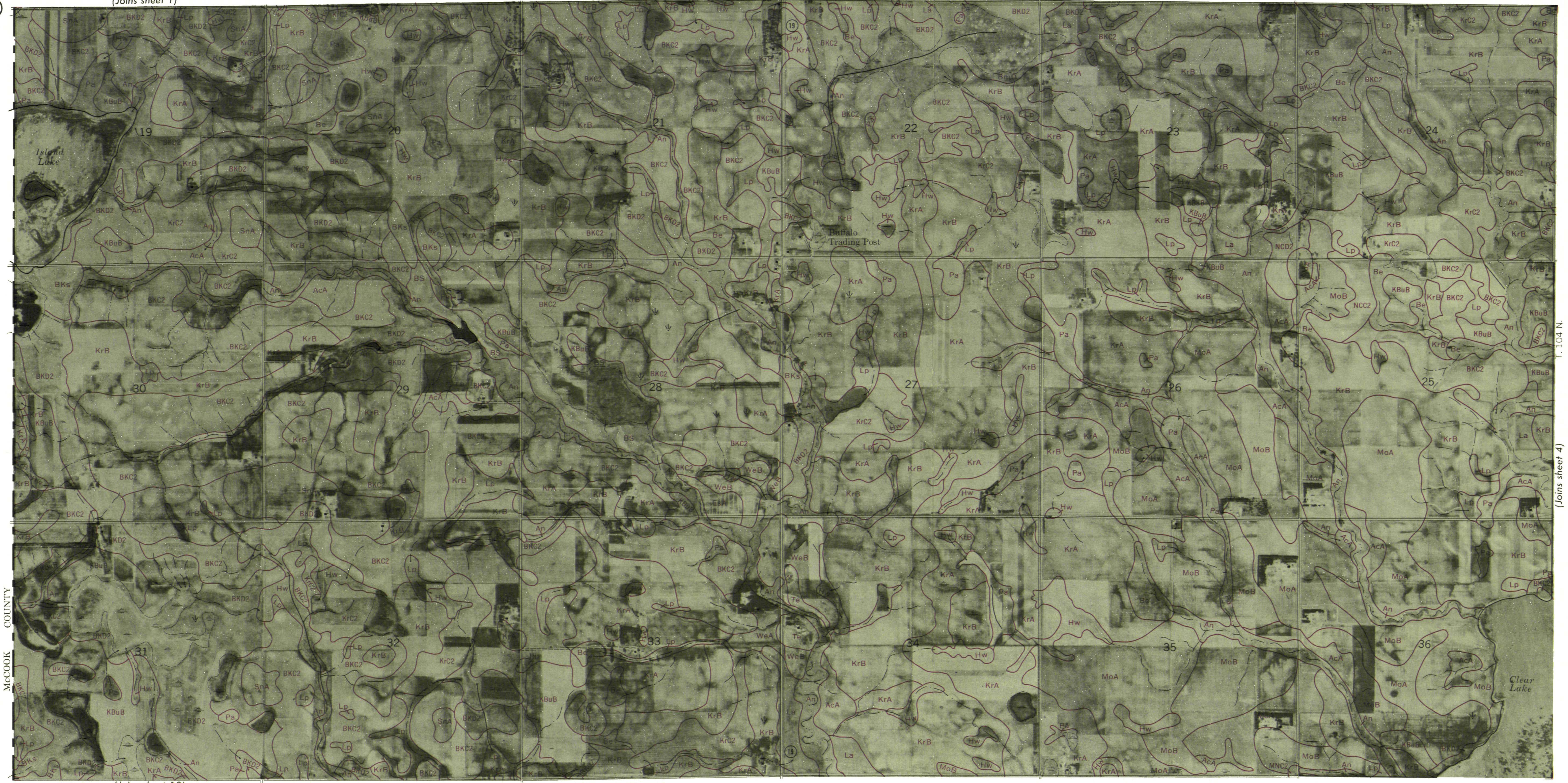
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

2

(Joins sheet 1)

R. 52 W.

N



T. 104 N.

(Joins sheet 4)

McCOOK COUNTY

(Joins sheet 13)

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22

(Joins sheet 21)

R. 48 W.

N

(Joins sheet 33)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

23

(Joins sheet 12)

(Joins sheet 21)

(Joins sheet 24)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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MINNEHAHA COUNTY, SOUTH DAKOTA — SHEET NUMBER 24

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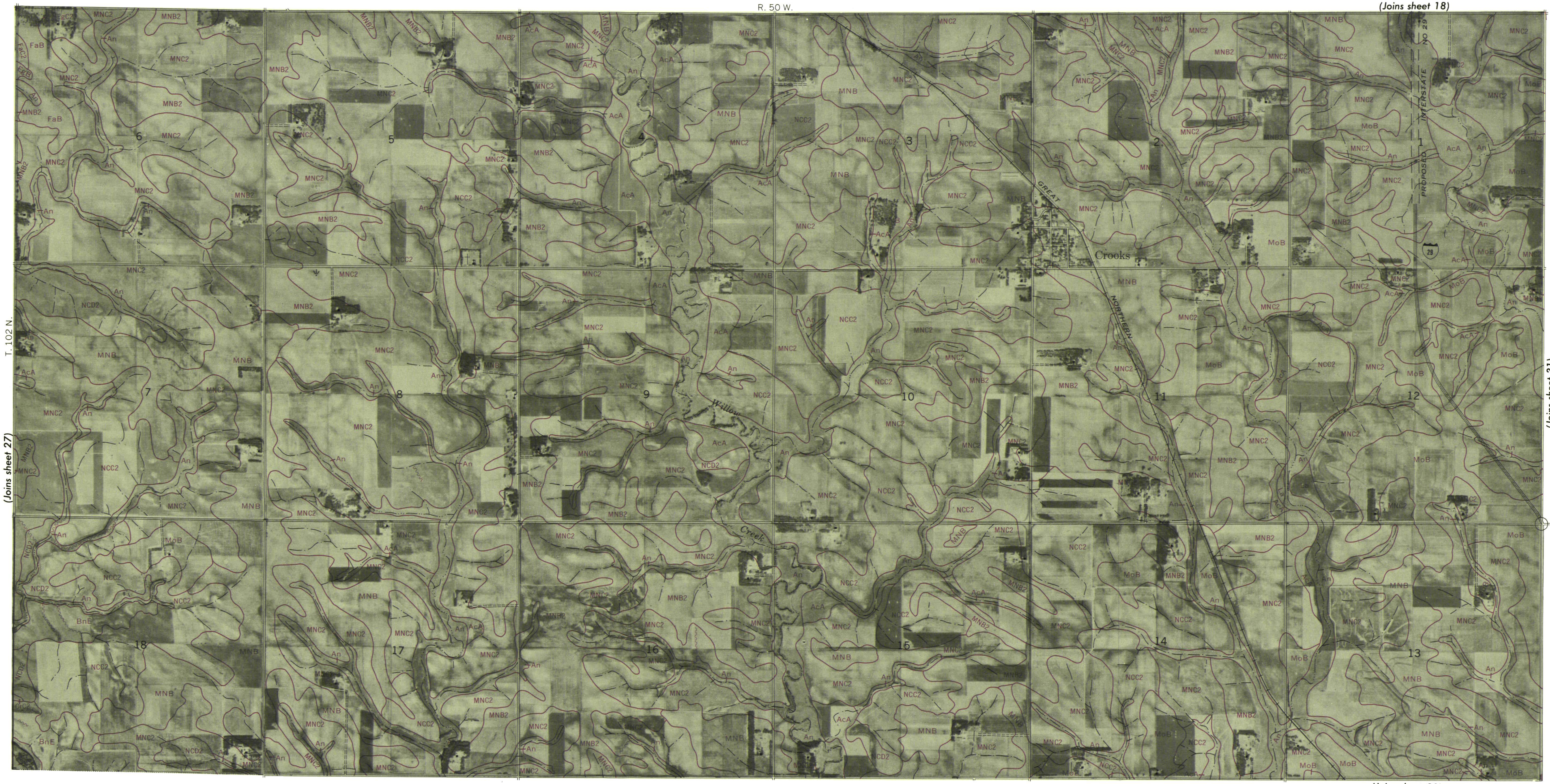

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3

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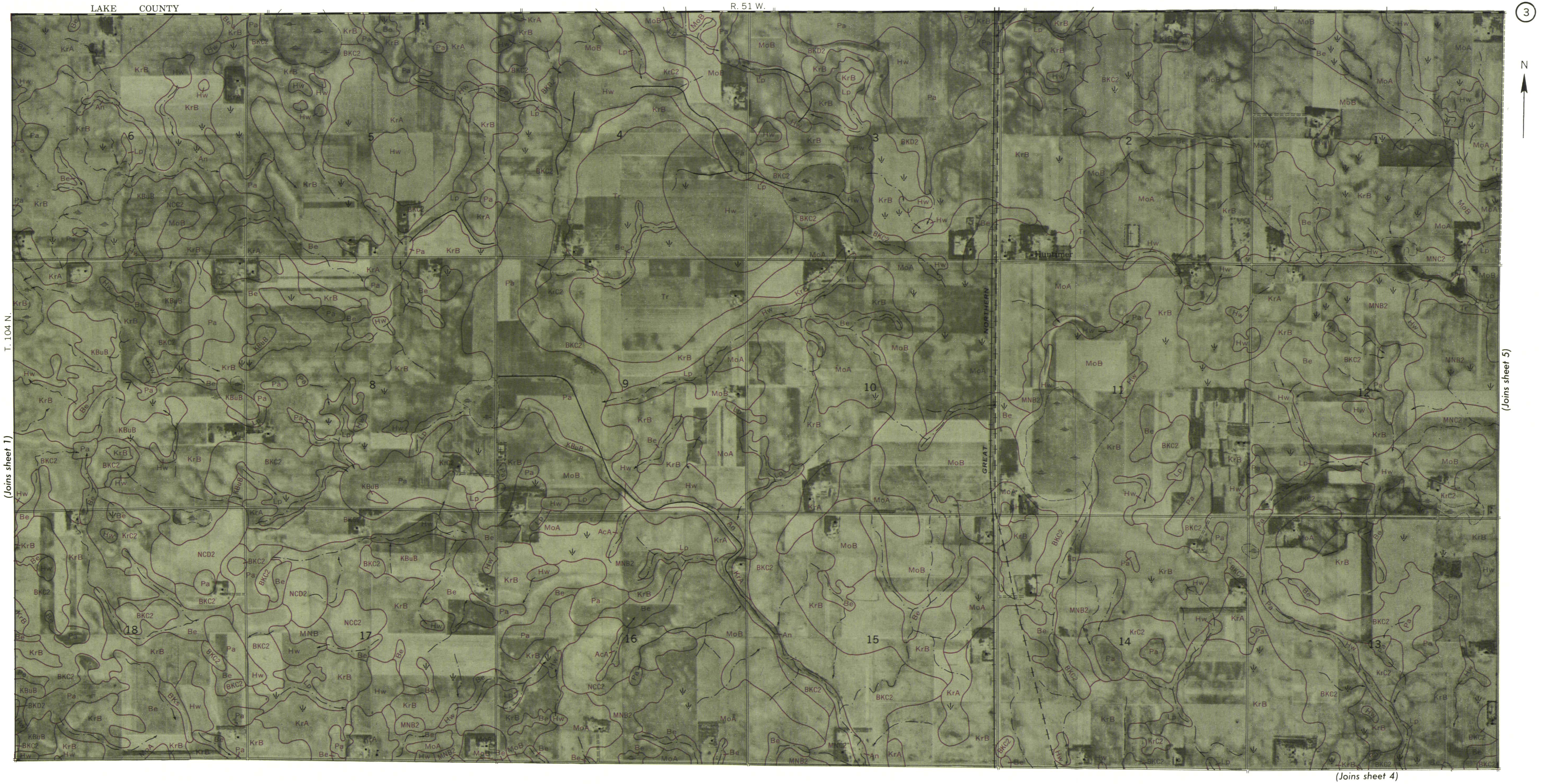

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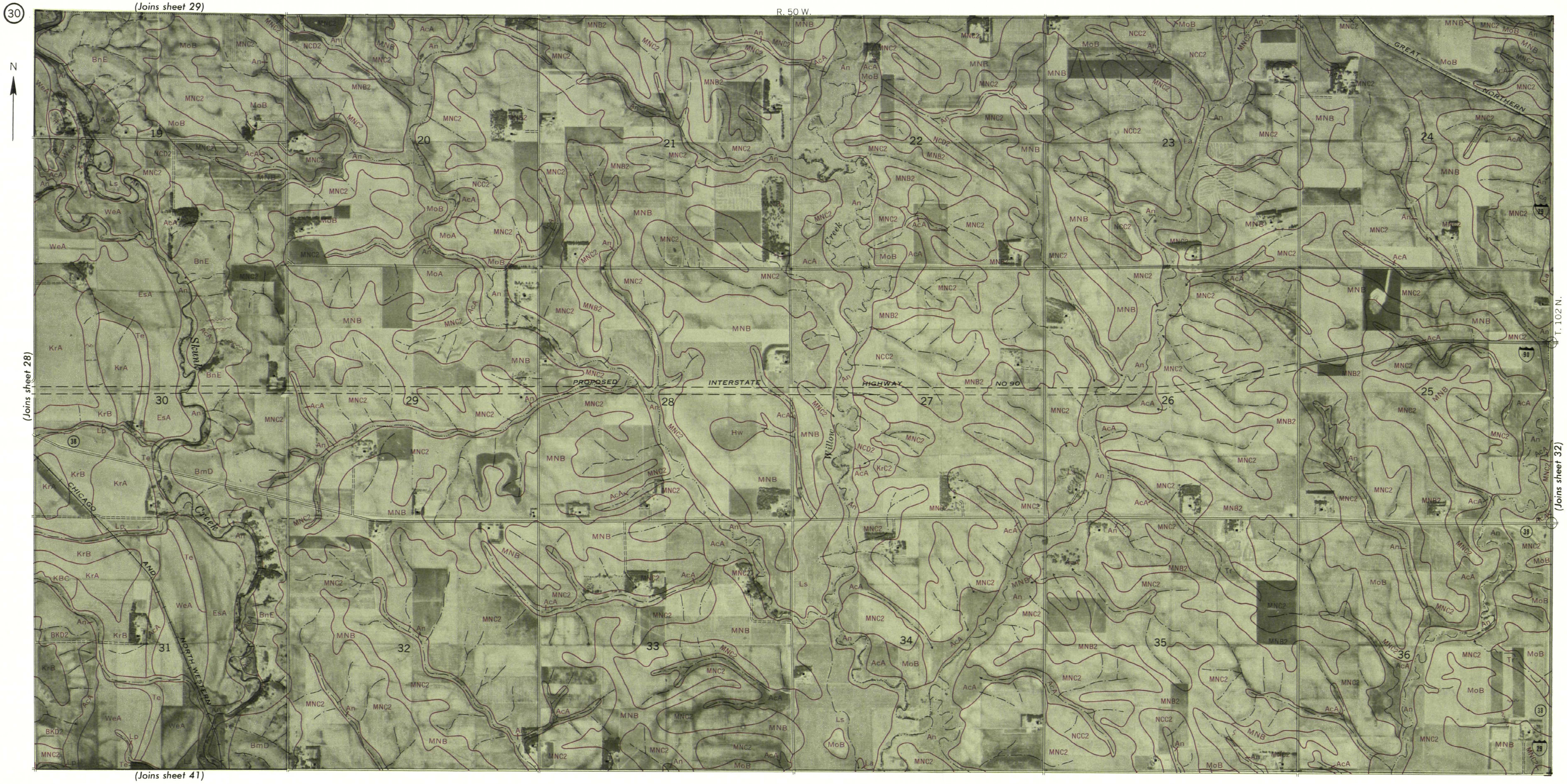

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0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

33

R. 48 W.

(Joins sheet 22)

N

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T. 102 N.

(Joins sheet 31)

(Joins sheet 35)

(Joins sheet 34)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

34

(Joins sheet 33)

(Joins sheet 32)

(Joins sheet 36)

(Joins sheet 45)

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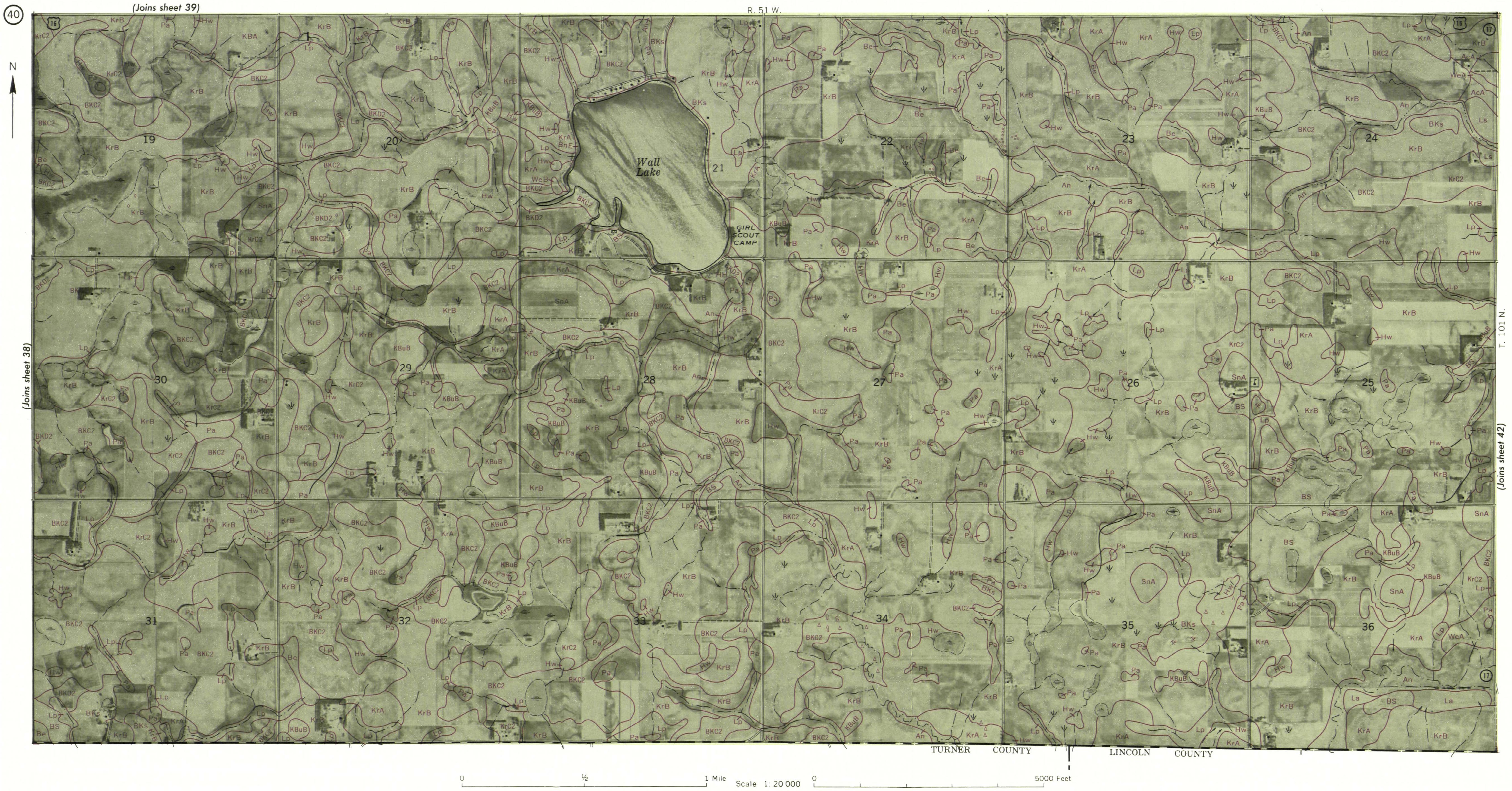
40
(Joins sheet 39)
R. 51 W.
N
(Joins sheet 38)
(Joins sheet 42)
T. 101 N.
Wall Lake
GIRL SCOUT CAMP
19
20
21
22
23
24
30
29
28
27
26
25
31
32
33
34
35
36
TURNER COUNTY
LINCOLN COUNTY
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

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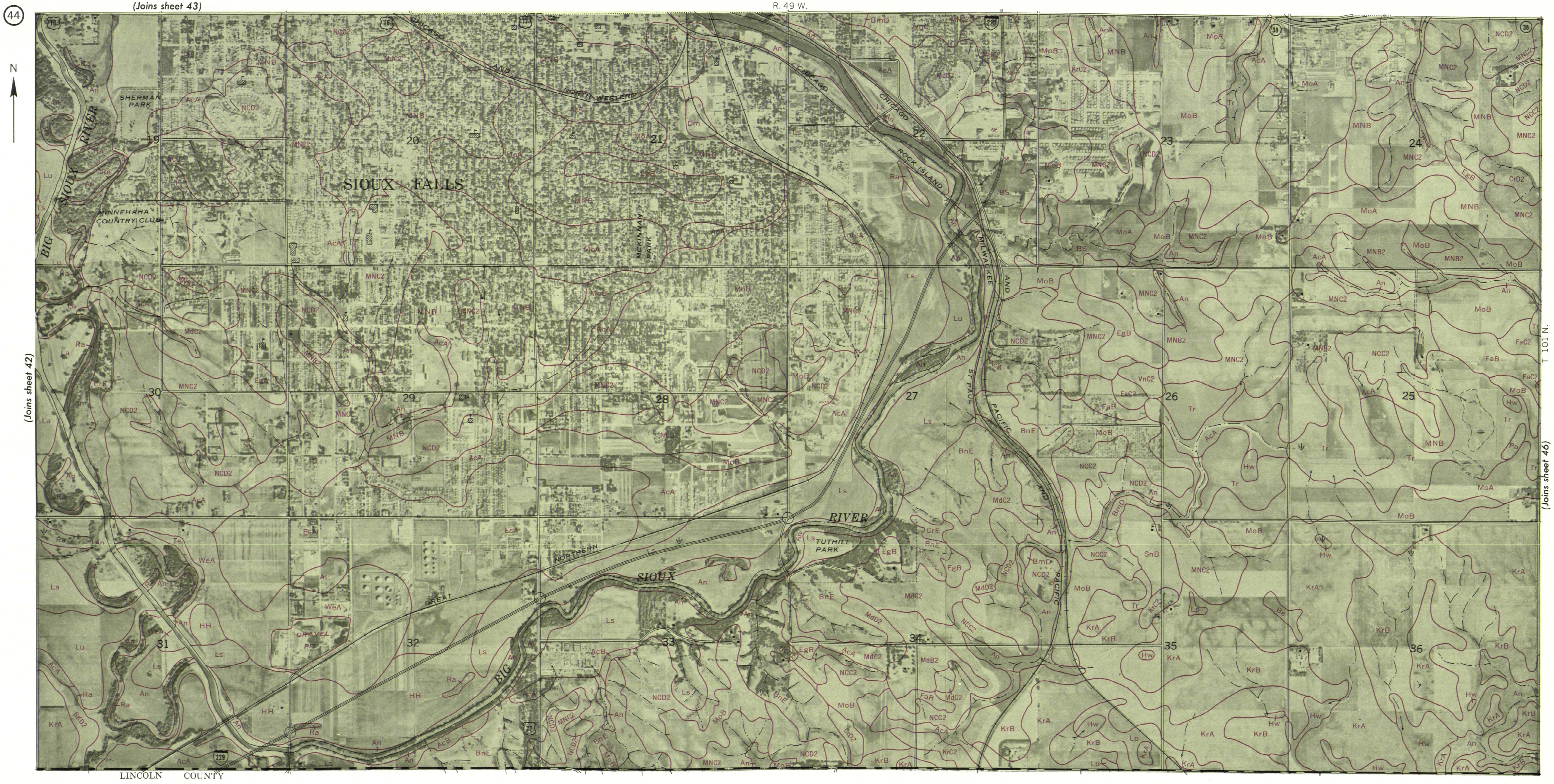

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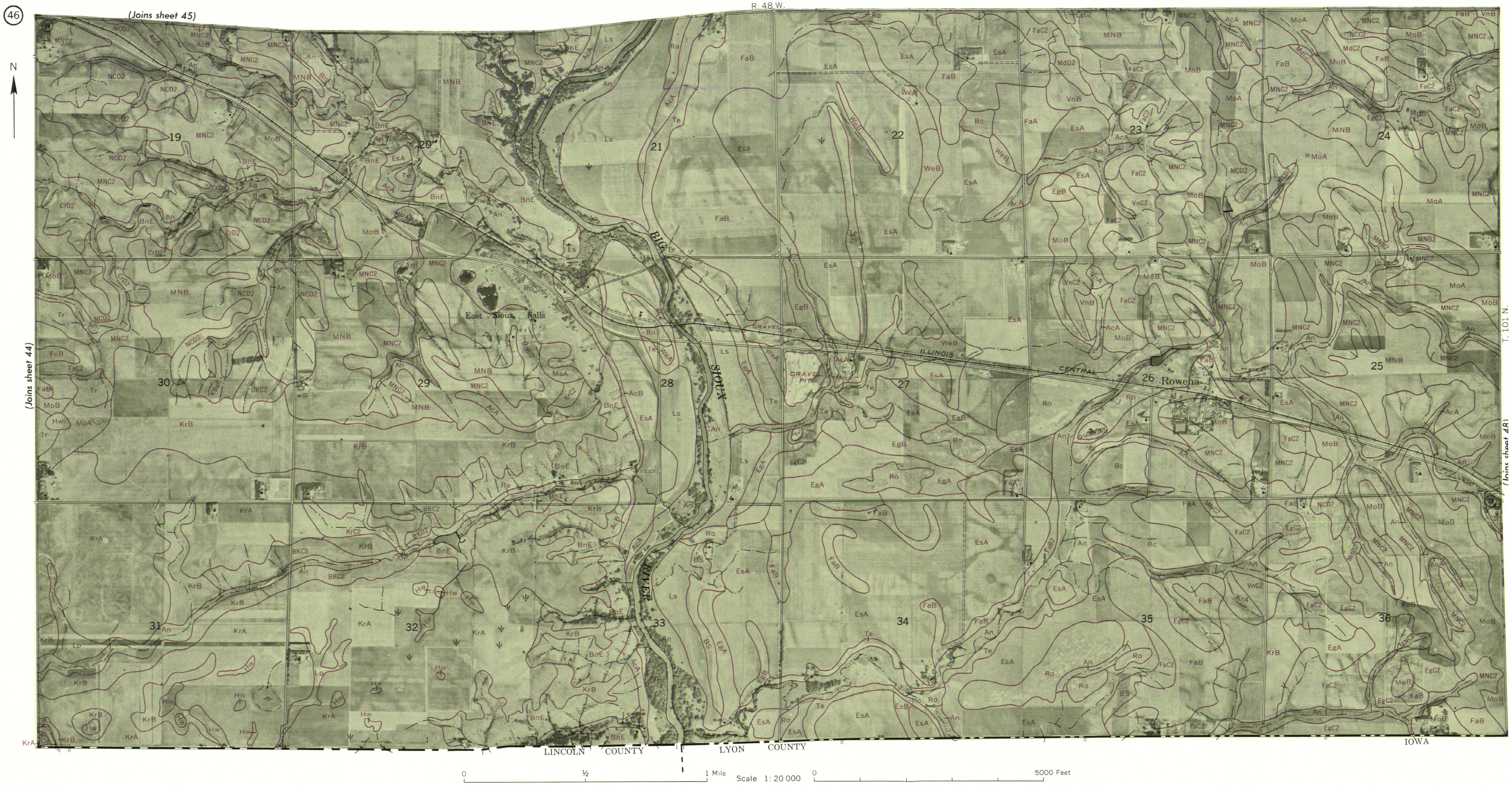
46
(Joins sheet 45)
(Joins sheet 44)
(Joins sheet 48)
R. 48 W.
T. 101 N.
N
East Sioux Falls
Rowena
BIG SIOUX RIVER
ILLINOIS CENTRAL
GRAVEL PIT
19
20
21
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36
LINCOLN COUNTY
LYON COUNTY
IOWA
0
½
1 Mile
Scale 1: 20 000
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5000 Feet

(Joins sheet 36)

(Joins sheet 48)

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7

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MINNEHAHA COUNTY, SOUTH DAKOTA — SHEET NUMBER 8

8

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